RAE SYSTEMS by Honeywell

FMC-4

4-Channel Controller
User's Guide

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SECTION 1: GENERAL INFORMATION

⚠ WARNINGS ⚠

This Manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

The following terms and symbols are used in this manual to alert the operator of important instrument operating issues:

This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions.

This symbol is intended to alert the user to the presence of dangerous voltage within the instrument enclosure that may be sufficient magnitude to constitute a risk of electric shock.

This symbol signifies the system's ground terminal

DC refers to direct current voltages.

VAC refers to alternating current voltages.

WARNINGS

- **SHOCK HAZARD!** Disconnect or turn off power before servicing this instrument.
- NEMA 4X wall mount models should be fitted with a locking mechanism after installation to prevent access to high voltages by unauthorized personnel (see Figure 4.0).
- Only the combustible monitor portions of this instrument have been assessed by CSA for 122.2 No. 152 performance requirements.
- This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D or non-hazardous locations only.
- **WARNING: EXPLOSION HAZARD!** SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.
- **WARNING: EXPLOSION HAZARD!** DO NOT REPLACE FUSE UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

- **WARNING: EXPLOSION HAZARD!** DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
- Use a properly rated CERTIFIED AC power (mains) cable installed as per local or national codes.
- For DC-powered units, DC power must be from a SELV rated source.
- A certified AC power (mains) disconnect or circuit breaker should be mounted near the controller and installed following applicable local and national codes. If a switch is used instead of a circuit breaker, a properly rated CERTIFIED fuse or current limiter is required to be installed as per local or national codes. Markings for positions of the switch or breaker should state (I) for on and (O) for off.
- Clean using only a damp cloth with no solvents.
- Equipment not used as prescribed within this manual may impair overall safety.

Parts & Accessories

Throughout this User's Guide you will see references to part numbers. These are internal part numbers for identification. Refer to the table on page 38 to find the ordering numbers if you need parts from RAE Systems.

Proper Product Disposal At End Of Life

The Waste Electrical and Electronic Equipment (WEEE) directive (2002/96/EC) is intended to promote recycling of electrical and electronic equipment and their components at end of life. This symbol (crossed-out wheeled bin) indicates separate collection of waste electrical and electronic equipment in the EU countries. This product may contain one or more Nickel-metal hydride (NiMH), Lithium-ion, or Alkaline batteries. Specific battery information is given in this user guide. Batteries must be recycled or disposed of properly.

At the end of its life, this product must undergo separate collection and recycling from general or household waste. Please use the return and collection system available in your country for the disposal of this product.

1.0 General Description

The RAE Systems FMC-4 Four Channel Controller is designed to display, and control alarm event switching for up to four inputs. Inputs are typically voltage or 4-20mA current from transmitters, monitors or other analog output devices. The FMC-4 is equipped with a Fault and three alarm levels per channel with features such as on/off delays, latching relays and alarm *Acknowledge.* A dedicated horn driver circuit for a local audible annunciator is also standard. Two standard 5-amp alarm relays are configurable via the "alarm voting" menu to make relays trip based upon various alarm combinations. Real-Time Clock and Calendar are also standard. Options such as 4-20mA outputs, discrete relays for each alarm and audible annunciators are easily added. RS-485 (Modbus RTU) or Ethernet (Modbus TCP) ports are also available for sending data to PCs, PLCs (programmable logic controllers), DCSs (distributed control system), or other RAE Systems controllers.

A 128 x 64 pixel graphic LCD readout displays monitored data as bar graphs, 30-minute trends and engineering units. System configuration is via user friendly menus and all configuration data is retained in non-volatile memory during power interruptions. The FMC-4 front panel is shown in Figure 1.0. The five button symbols below the display are magnetically activated using the supplied magnetic wand without opening the enclosure. Opening the enclosure door provides access to the "touch" keypad as shown in Figure 1.1.

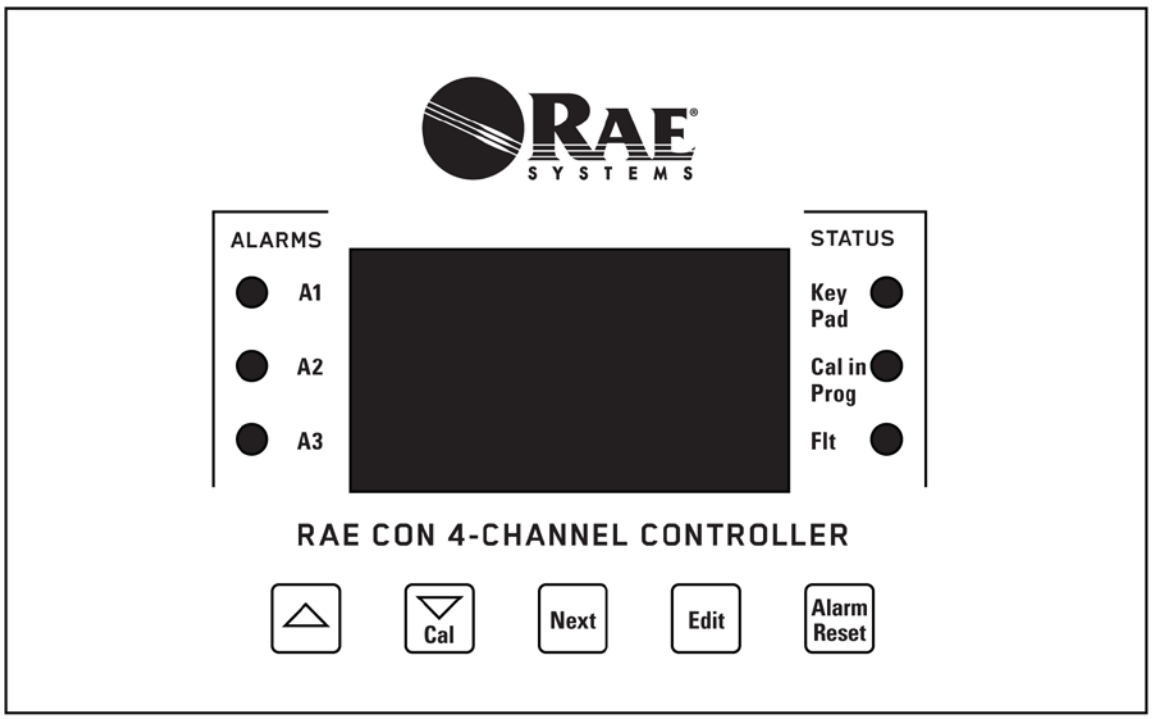


Figure1.0

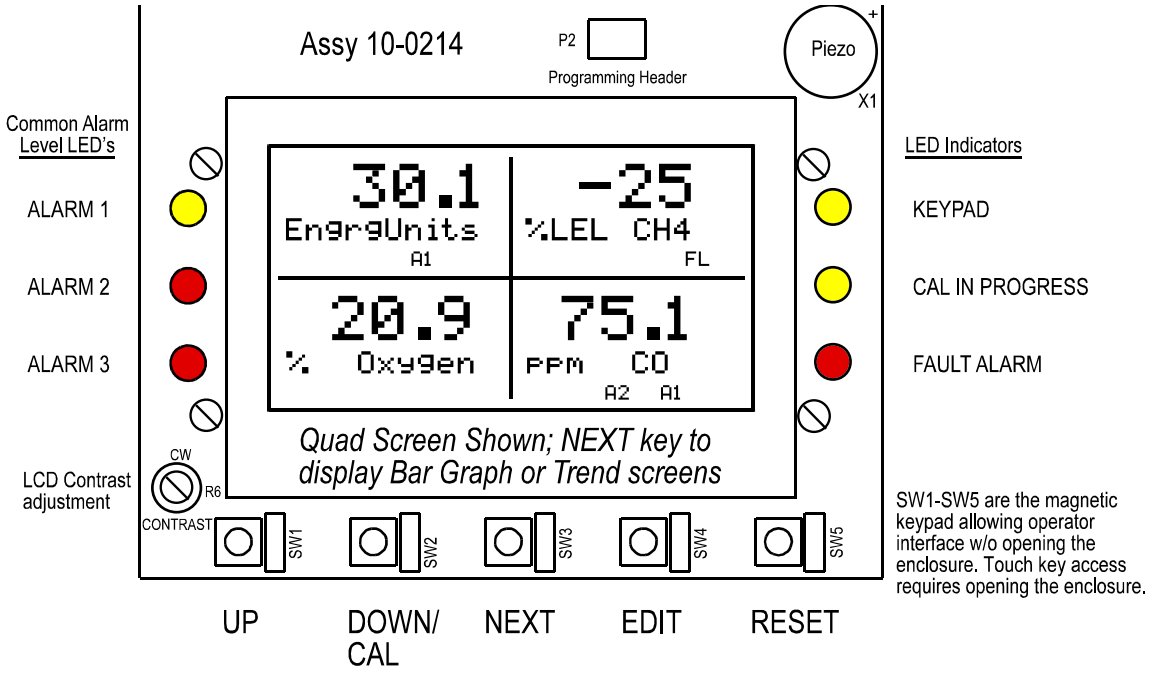
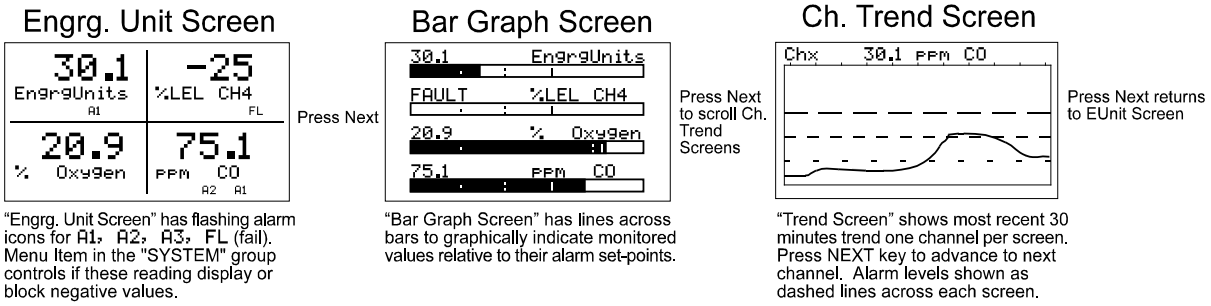


Figure1.1

1.1 Data Display Screens

The FMC-4 Controller offers three modes for displaying monitored data. Each are shown in Figure 1.2.



"Engrg. Unit Screen" has flashing alarm icons for A1, A2, A3, FL (fail). Menu Item in the "SYSTEM" group controls if these reading display or block negative values.

"Bar Graph Screen" has lines across bars to graphically indicate monitored values relative to their alarm set-points.

"Trend Screen" shows most recent 30 minutes trend one channel per screen. Press NEXT key to advance to next channel. Alarm levels shown as dashed lines across each screen.

Figure 1.2

1.1.1 Engineering Unit Screen

The FMC-4 *Engineering Unit* screen shown at left in Figure 1.2 allows each channel's value and its 10-digit Eunits tag to be viewed simultaneously. A1, A2, A3, FL icons at lower right of each reading flash if ALARM 1, 2, 3 or FAULT alarms activate for this channel.

1.1.2 Bar Graph Screen

Values are displayed graphically as bar graphs with alarm levels indicated by vertical dashed lines across each bar. The bar graph screen is very useful for emphasizing current reading relative to the channel's alarm set-point. Live readings and their Eunits tag appear above each bar graph.

1.1.3 Trend Screen

The FMC-4 also provides 30-minute trend screens for each channel as shown in Figure 1.2. Live readings and their Eunits tag are displayed across the top of each trend screen. Channel numbers are shown in the upper right and are selected by the NEXT key. A1, A2, and A3 alarm levels appear as horizontal dashed lines across the screen.

1.2 Specifications

1.2.1 Power Supply Requirements

FMC-4 primary power may be either 10 to 30 VDC or 100 to 240VAC. AC power requirements are 100 to 240 VAC 50/60 Hz @ 0.80 amp max (including inrush) and 40 watts maximum steady state, applied to TB5 on the motherboard. If AC power is not available, the primary power may be 10 to 30 VDC applied to TB1 on the motherboard. A backup DC power source may also be connected to TB1 for automatic switchover if the AC power source fails. See Figures 3.0 and 3.1 for wiring information.

The basic FMC-4 consumes only 1.5 watts of 10 to 30 VDC power. Optional features such as relays and analog outputs increase power consumption as described below:

- **Analog Input PCB** option (part number 10-0221-4): add wattage for each monitor connected to this board's 24 VDC terminals.
- **Discrete Relay PCB** option (part number 10-0222): add 1.5 watt.
- **4-20mA Output PCB** option (part number 10-0308): add 1 watt.
- **Bridge Sensor Input PCB** option (part number 10-0309): add wattage of each sensor attached.

With an AC primary power source connected to TB1 on the motherboard, TB3 terminals 1 & 2 on the motherboard provide a maximum of 10 watts of output power for powering auxiliary external devices such as relays, lights, and monitors (see Figure 3.0). Power consumed from TB3 must be included when calculating system power consumption.

IMPORTANT! TB3 only provides 24VDC power when AC is the primary power.

24 VDC terminals on the 10-0221-4 Analog input option (see Figure 3.3) is typically used to power external transmitters up to 10 watts per channel and these loads must also be calculated into the overall power budget. These terminals receive power from both the integral AC/DC power supply and the external TB1 supply as shown in Figure 3.0.

Some applications may require 24VDC power in excess of that available from the FMC-4's AC power supply on the motherboard and thereby require another 50-watt AC/DC supply. NEC Class 2 50-watt external supplies are available for Division 1 (P/N 10-0314) and Division 2 (P/N 10-0315) potentially hazardous area installations. Both also include a NEMA 4X weather rating.

Extended series enclosures described in Section 4 of this guide may include the 1000-2259 DIN rail-mounted 50-watt Power Supply module built into these larger enclosures.

1.2.2 Relays

Two mechanical (dry contact) Common Form C relays are standard and may be mapped to various alarm events as described in section 2.3.1. FMC-4s may also be equipped with optional solid-state common Form A relays in applications requiring non-arcing switching. Solid-state relays are recommended for switching of highly inductive loads.

A six mechanical (dry contact) Discrete Relay option board (see section 3.1.6) provides dedicated Form C relays for ALARM 1, ALARM 2 and FAULT for both channels.

All mechanical (dry contact) relays are rated at 5 Amp for 28 VDC and 250 VAC resistive loads.

IMPORTANT: Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes.

Optional solid-state relays are rated at 2 Amp, 12 to 280 VAC (600Vpk).

Relay wiring should be kept separate from low-level signal wiring.

1.2.3 Ambient Temperature Range

-25° to 60° C

1.2.4 Humidity Range

0 to 90% relative humidity, non-condensing.

1.2.5 Altitude

Recommended up to 2,000 meters

1.2.6 Housings/Installation Categories

- *NEMA 4X wall mount. Div 2 Groups A,B,C,D; Category II and pollution degree 3; NEMA 4X; IP66
- *NEMA 7 wall mount for Div 1 & 2 Groups B,C,D; includes 'O' Ring in door to satisfy NEMA 4 rating.

*Includes standard non-intrusive magnetic keypad.

1.2.7 Approvals

CSA C22.2 No 1010.1 and ISA S82.02; CSA C22.2 No 152 for combustibles; UL 1604 / C22.2 No 213 (Div 2 Groups A,B,C,D); EN55011 & EN61000 (CE Mark). CSA File # = 219995 and may be seen at: CSA-International.org.

SECTION 2: OPERATION

2.0 Basic Operation

The FMC-4's graphic LCD displays monitored data, and with the 5-button keypad also serves as the system's operator interface. All FMC-4 configuration variables are entered with this operator interface using SETUP menus accessed by pressing EDIT from either data screen. This *Setup* mode may be exited manually by pressing NEXT**,** or automatically when no keys are pressed for 5 minutes. Alarm relays and front panel alarm LED indicators remain active during the *Setup* mode. Alarm LED's flash upon new alarms and become steady after *Acknowledged* by pressing the ALARM RESET key. A SECURITY menu offers a password feature to prevent tampering with FMC-4 parameters.

A "sign-on" screen appears briefly after power is applied that indicates what type input / output options the unit is configured with.

2.1 Setup Menu Configuration

Variables inside the CHANNEL (see section 2.2) and SYSTEM (see section 2.3) menu trees allow FMC-4 configuration for a wide range of monitoring applications. Select the desired menu by scrolling with UP/DOWN and then EDIT to enter each menu. Figure 2.0 illustrates the menu tree for configuring Channel- and System-specific variables. *Channel* variables affect only the specific channel selected, while *System* variables are related to features not specific to any channel.

QUAD Channel Controller Menu Tree

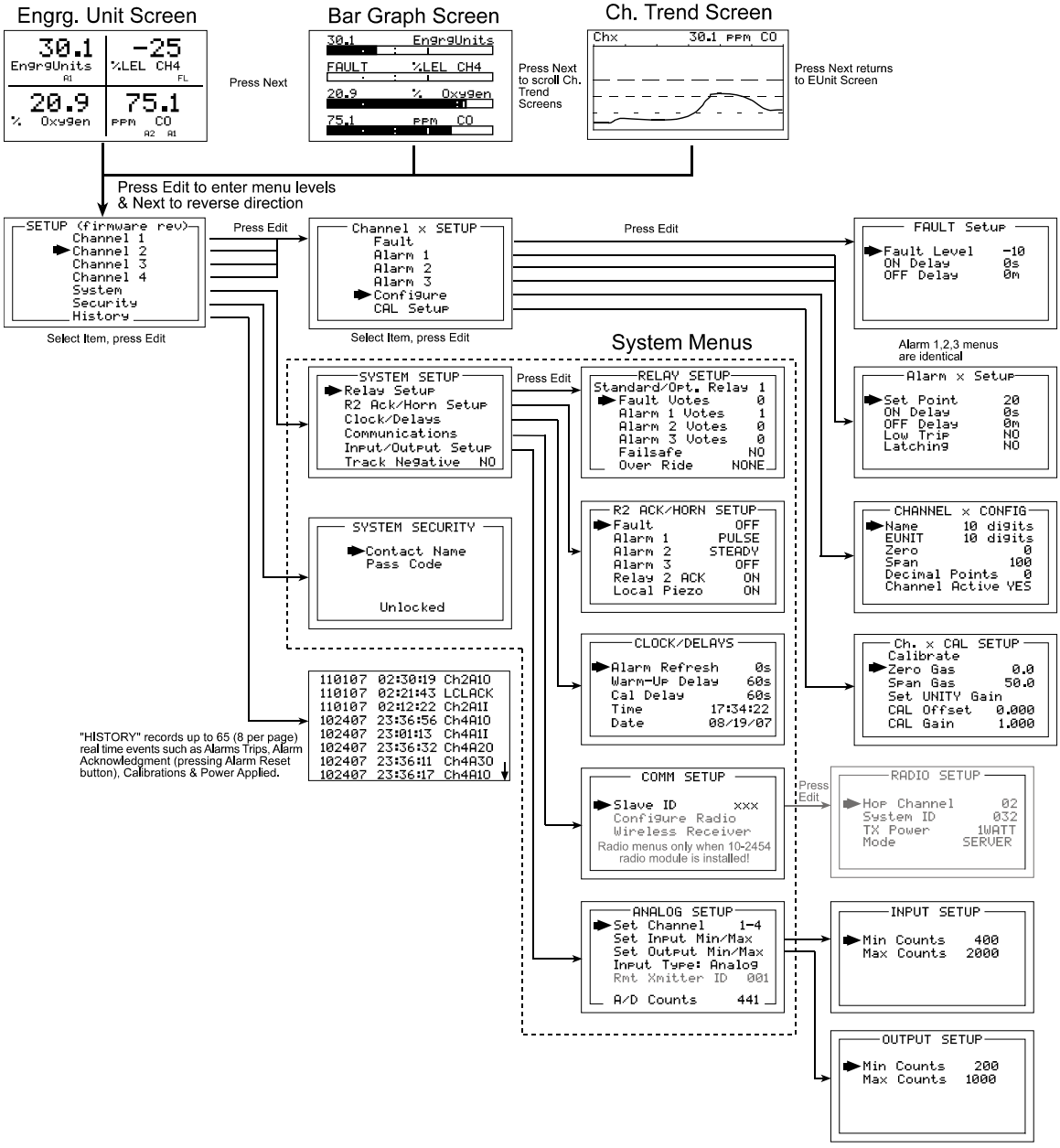

Engrg. Unit Screen
Bar Graph Screen
Ch. Trend Screen
Press Next
Press Next to scroll Ch. Trend Screens
Press Next returns to EUnit Screen
Press Edit to enter menu levels & Next to reverse direction
Press Edit
Select Item, press Edit
System Menus
Alarm 1,2,3 menus are identical
"HISTORY" records up to 65 (8 per page) real time events such as Alarms Trips, Alarm Acknowledgment (pressing Alarm Reset button), Calibrations & Power Applied.
Radio menus only when 10-2454 radio module is installed!

Figure 2.0

2.2 Changing Menu Variables Using The Keypad

Upon entering a menu, a pointer controlled by the UP/DOWN keys indicates the selected variable. Some are simple YES/NO or ON/OFF entries toggled by pressing the EDIT key. Others, such as Channel ID and Eunits fields may have many ASCII character possibilities.

Allowed ASCII characters are as follows:

ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz blank space !"#$%&`()*+,-./0123456789:;<=>?@.

Notice the often used *blank* character is located after lower-case "z" and before the exclamation point (!). EDIT places a cursor under the item, and UP/DOWN scrolls through each allowed entry. The NEXT key moves the cursor to the next position within a field. When the field is complete, EDIT clears the cursor and loads the field into non-volatile memory where it is retained indefinitely. Without a cursor present, the NEXT key closes open menus in reverse order and returns the LCD to the data display.

2.2.1 FMC-4 Setup Configuration Menus

The SETUP menu shown in the middle of Figure 2.0 and in Figure 2.1 is reached by pressing EDIT with any data display present. This is the entry-level screen to all Channel, System and Security menus. It also shows the revision of firmware operating in the FMC-4. Use the UP/DOWN keys to move the pointer to the desired menu and press the EDIT key.

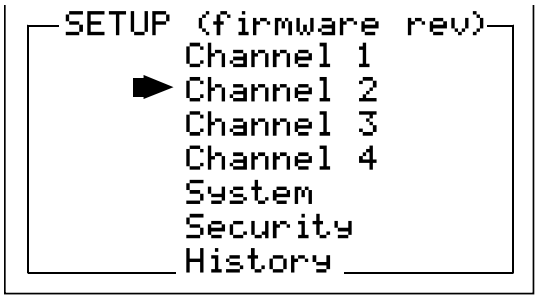


Figure 2.1

2.2.2 Channel Setup Entry Menu

The CHANNEL menu shown below in Figure 2.2 allows configuration of all variables for the selected channel. These are **Fault, Alarm 1**, **Alarm 2**, **Alarm 3**, **Configure** and **CAL Setup**.

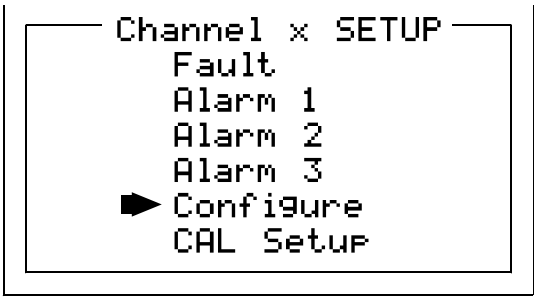


Figure 2.2

2.2.3 Fault/Alarm 1/Alarm 2/Alarm 3 Setup Menus

Alarms 1, 2 and 3 have identical menus. The only difference between each is A1 front panel LED indicators are yellow while A2 and A3 are red. Typical applications often have A1 set at a WARN level, A2 at a HIGH level and A3 at a higher SHUT DOWN level. However, it is important to understand there is no functional difference between A1, A2 and A3 and since their configuration menus are identical, only one is shown in Figure 2.3. The Fault menus is identical to A1, A2, A3 except Fault alarms are always low trips (alarm activates as input goes below the set point) and Fault alarms may not be set for latching operation.

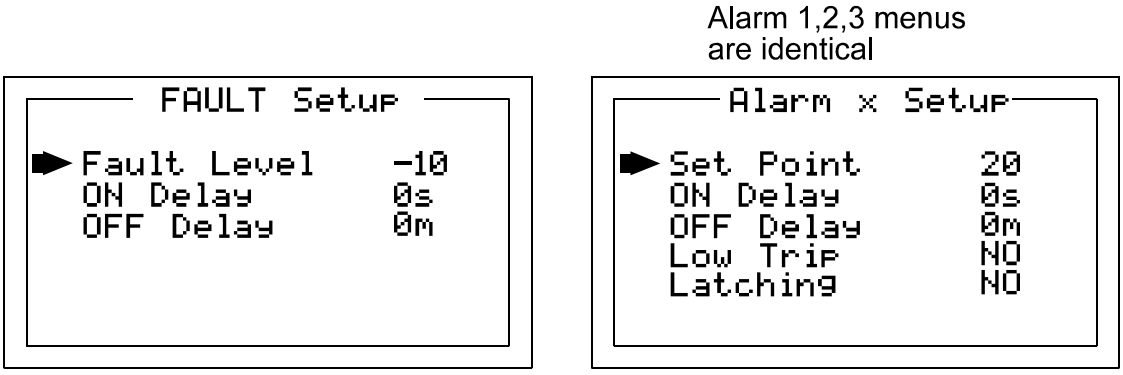


Figure 2.3

- **Set Point** is entered in engineering units and determines the value where the alarm trips. For example, if a channel monitors 0-50 ppmH2S and the desired alarm level is 10 ppm, the correct entry is 10.00. A one percent dead band prevents alarm chatter. This means after tripping an alarm the input must move at least 1% of full scale back through the setpoint for the alarm to auto reset.
- The **ON Delay / OFF Delay** entries allow **ON** and **OFF** time delays affecting how long the trip-point must be surpassed before an alarm event transition occurs. **ON** delays are limited to 10 seconds while **OFF** delays may be as long as 120 minutes.

Delays are useful in many applications to prevent nuisance alarms and unwanted cycling into and out of alarm conditions.

- **Low Trip** is set for **NO** for increasing alarms or **YES** for decreasing alarms to determine if the alarm activates upon exceeding or falling below the set-point.
- **Latching** determines either manual or automatic alarm reset operation. **YES** requires a manual **Alarm Reset** to unlatch the alarm even though an alarm condition no longer exists. **YES** also causes this alarm's common relay, front panel LED, and optional discrete relay to latch. **NO** allows all outputs for this alarm to automatically reset after the alarm condition clears.

Common alarm LED indicators on the left side of the front panel indicate the status of A1, A2 A3 alarms. The common Fault LED is on the lower right side of the front panel. Any *new* alarm event causes the associated LED to flash until an **Alarm Reset** occurs causing an *acknowledged* steady on condition. Operators should recognize *new* alarms by a flashing LED. **Alarm Reset** also *acknowledges*, or deactivates, audible devices driven by the AUDIBLE ALARM option connector J2 (see Figure 3.1)

2.2.4 Configure Menu To Define Channel

The channel setup menu after the alarm menus is **CONFIGURE.** It allows setting **Name** and **EUNIT** 10 digit ASCII fields, defines the measurement range with **ZERO** & **SPAN** entries, number of **Decimal Points** of resolution the reading will have, and if the channel is **Active**.

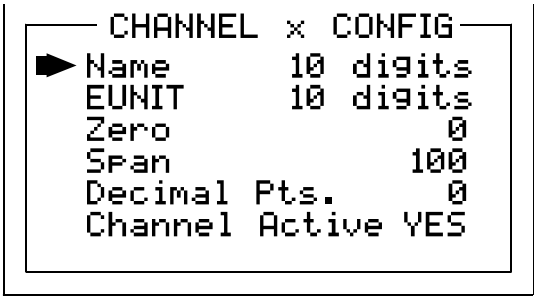


Figure 2.4

2.2.4a Name/Eunits ASCII Data Fields

The first two items in this menu are for entering the 10 character channel *Name* and *engineering unit* ASCII fields. *Name* should describe the channel's data in user terminology such as tag # or other description. *Eunits* should define the units of measure for what this channel is to display. Section 2.2 describes how to modify these fields using the keypad.

2.2.4b Input Measurement Range

The **Zero/Span** menu entries allow configuration of the measurement range displayed by this channel. Measurement Range defines the range of the input signal's engineering units. For example, if a channel's input is 4-20mA from a transmitter monitoring 0 to 10ppm chlorine, then the **Zero** value should equal 0.000 and the **Span** value equal 10.00. Four digits must be entered so trailing 0's may appear here that are not displayed on other

data screens. These menus work hand in hand with Min/Max Raw Counts menus described in section 2.3.4.

2.2.4c Decimal Point Resolution

Resolution of the displayed channel value is configured in this menu by setting the number digits trailing the decimal point. Displayed readings are limited to a maximum of four digits with a polarity sign. Auto-ranging displays the highest resolution allowed by this menu's decimal point entry. For example, a range of 0 to 100ppm and two decimal points reads **0.00** at 0ppm and **100.0** at 100ppm. This may be undesirable due to the high resolution at zero unless the sensor's output is extremely stable. If decimal points are limited to one, the 0ppm reading becomes **0.0** and the 100ppm reading remains **100.0**. Resolution may be limited further by setting decimal points to 0 where in the above example, 0ppm reads **0** and 100ppm reads **100**.

2.2.4d Turning Off Unused Channels

The **Channel Active?** menu entry asks if this channel is to be utilized. **OFF** causes the controller to never process inputs applied to this channel and no alarms are tripped or data displayed. Inactive channels have a line drawn through them on the Setup screen to indicate it is turned off.

2.2.5 Cal Setup Mode

The FMC-4 CAL MODE feature supports pushbutton calibration of zero and span values. This feature should be utilized only when there are no other zero/span controls within the monitoring system since it is inappropriate to calibrate a signal at more than one point. Therefore, if calibration will be performed at another transmitter or monitoring device, the FMC-4 CAL MODE feature should not be used.

The **CAL SETUP** menu allows entering the correct **Zero** & **Span Gas** set-point values needed to calibrate the channel. These are entered in the same engineering units as input range.

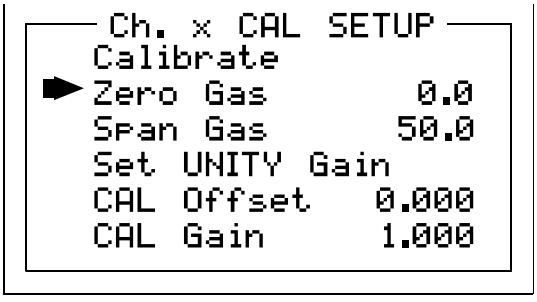


Figure 2.5

2.2.6 Calibrate Input Menu

The CAL MODE (flow chart shown in Figure 2.6) is designed to make calibration quick, easy and error free. A successful ZERO and SPAN calibration requires only a few keystrokes. Optional 4-20mA outputs (if equipped) transmit 1.5mA during CAL MODE and 4mA during the subsequent CAL DELAY to prevent external alarms during

calibration. Local FMC-4 alarm relays are inhibited during CAL MODE. Unintentional calibrations may be reset by the **Set UNITY** menu item. **Set UNITY** resets **Cal OFFSET** to 0 & **Cal GAIN** to 1 which is useful for returning the calibration to a known starting place. Sensor aging may be monitored by recording zero and span readings at **Unity Gain** when the sensor is new, and again later when degradation may have occurred. CAL MODE automatically exits if no keystroke is detected after 5 minutes.

Use the following step-by-step procedure to perform ZERO and SPAN calibrations.

1. To enter the CAL MODE from any data display, press the dual purpose DOWN / CAL key then use the UP/DOWN keys to select the channel to calibrate.
2. Stimulate the monitor to be calibrated with an appropriate ZERO calibration standard. Observe the screen's live reading and when it is stable press the EDIT key to perform the ZERO calibration.
3. If the ZERO calibration is successful, CAL MODE automatically proceeds to the SPAN check.
4. Apply the correct SPAN calibration standard. After the reading is stable, press the EDIT key to perform a SPAN calibration.

   WARNING: The SPAN calibration standard used must match the value specified since this is the reading the FMC-4 will indicate after a successful SPAN calibration. The SPAN calibration value may be edited if it becomes necessary to apply a different calibration standard to set SPAN (see Span Calibration in section 2.2.5).
5. If the SPAN calibration is successful, the display flashes "REMOVE CAL GAS" and starts the CAL DELAY.
6. CAL MODE will be complete after the end of the CAL DELAY.

The flow chart in Figure 2-6 illustrates the above procedure. **UP**, **CAL**, **NEXT** & **EDIT** labels indicate keystrokes (**CAL/DOWN** is a dual purpose key). The CAL MODE information screen (top of the chart) is available for advanced users to see Offset / Gain calibration constants and live analog to digital converter (A/D) counts. Span set point calibration values may also be edited from this screen. Holding the **UP** key, for 5 seconds during CAL MODE, displays this screen.

Unity Gain may be used at any time to cancel incorrect calibrations and start again. Unity means Offset = 0.00 and Gain = 1.00.

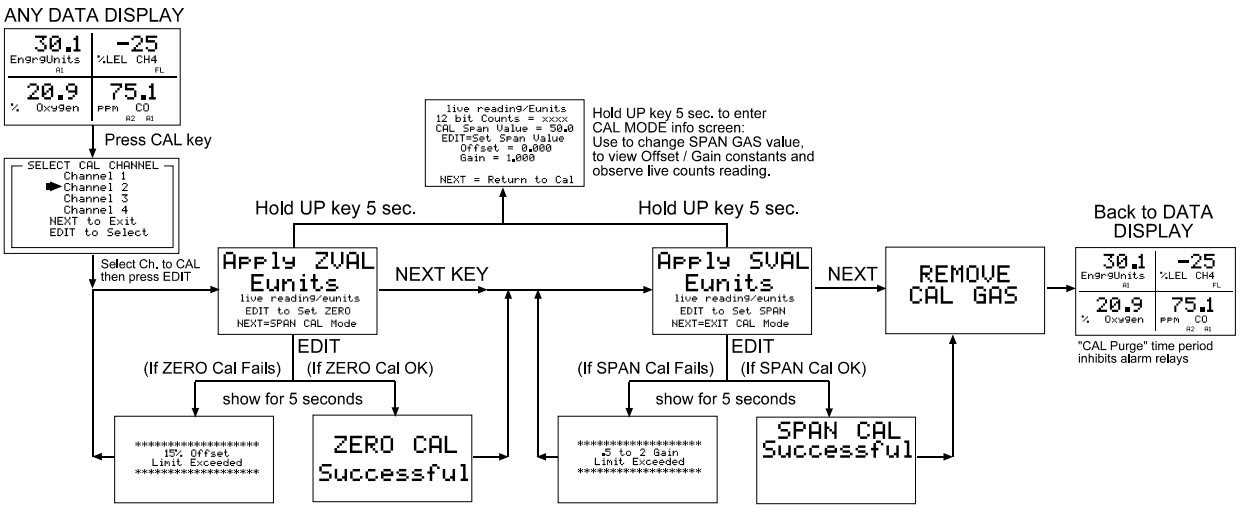


Figure 2.6

2.3 System Configuration Menus

Several items needing configuration are not specific to either channel but affect the entire FMC-4 *system*. These are located in the *SYSTEM* menus group shown in the dotted line box in Figure 2.0. System menus are accessed through the System SETUP menu shown in Figure 2.7 by pointing to the desired item and pressing **EDIT**.

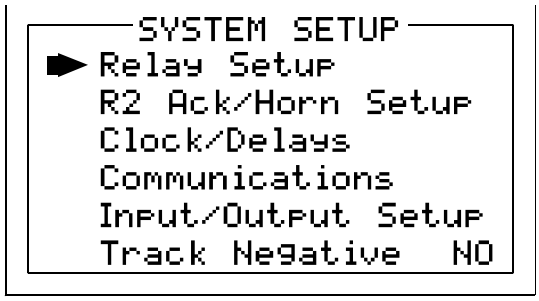


Figure 2.7

2.3.1 Standard/Optional Relay Setup Menus

The menu shown in Figure 2.8 allows configuring of both the standard **Relay 1** & **Relay 2** motherboard relays and the six optional relays on the 10-0222 discrete relay option PCB. Both standard and optional relays are programmed in this menu. Select the relay to be configured by pointing the arrow at the top menu item and pressing EDIT. The field will scroll through all eight possible relays (2 standard and 6 optional).

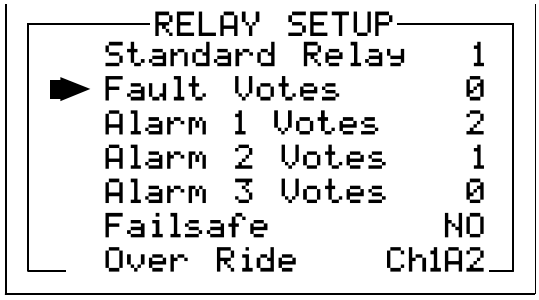


Figure 2.8

- **Fault, Alarm 1, Alarm 2, Alarm 3** menus in Figure 2.8 offers additional "voting" flexibility by controlling the channel alarm combinations that will trip the selected relay. Each ***Votes*** entry requires this quantity of channels, for of each type alarm be active before this relay activates. As illustrated in Figure 2.8 above, Standard Relay 1 activates when any 2 channels have Alarm 1 conditions, PLUS, any one channel has an Alarm 2 condition. And since the **Over Ride** menu (see description below) contains the **Ch1A2** entry Standard Relay 1 also activates if alarm 2 on channel 1 trips. Fault Votes and Alarm 3 Votes values are 0 therefore Fault and Alarm 3 conditions will not affect this relay. Votes follow the logical "AND" function.
- **Failsafe** set for YES causes this relay to be energized when its voting requirements are false (no alarm condition) and de-energized when the alarm vote requirements are true. The primary benefit of **Failsafe** is loss of power places the relay contacts into the alarm condition.
- **Over Ride** menu allows entering one of the 16 different alarms that will trip this relay regardless of the ***Votes*** entries. There are four alarms per channel and four channels. Any one of these 16 alarms may be used as the Over Ride. This feature is useful when one channel's alarm has more significance than the others; perhaps a flame detector.
- **"Sympathy"** alarms are also configured in the **Over Ride** menu. When FMC-4 controllers are sending their modbus data to an ST-72 controller, it is possible to configure the ST-72 to return a trip command to the relay of all FMC-4s configured with a sympathy alarm that are on the same modbus network. This feature is especially useful when several FMC-4/QAUD controllers are combined to monitor a perimeter. It makes it possible for an alarm detected at one controller to trip an alarm at the others. An example is instead of only a strobe light at the unit with the alarm flashing its' strobe, the **Sympathy** feature allows all units to flash their strobe in "sympathy" to the unit with the actual alarm condition.

SympFlt, **SympA1**, **SympA2**, or **SympA3** are the sympathy alarm options available. A **Sympathy** mode in our ST-72 controller broadcasts the **Sympathy** over ride when it detects an alarm condition from another network controller. When a sympathy alarm is entered into this field, and the correct **Sympathy** setup is configured into the ST-72 controller, the FMC-4 relay will energize when the corresponding alarm level is reached at another FMC-4 controller that is part of the network. The alarm level is assigned to the relay by entering one of the four possible sympathy overrides - **SympFlt**, **SympA1**, **SympA2**, or **SympA3.** When the relay has **Sympathy** override assigned, the FMC-4 accepts a broadcasted alarm flag from the ST-72. The active **Sympathy** alarm condition causes the screen to flash **Sympathy** and energize the relay. With these settings, if four FMC-4s are setup in a perimeter monitoring application and a **Sympathy** override is assigned to a relay at each powering a local strobe light, then all the strobes will be activated when any one of the sensor points at any FMC-4 goes into alarm.

2.3.2 Relay 2 Ack (Acknowledge)/Horn Setup Menu

- The **Horn SETUP** menu controls how each alarm type (Fault, and Alarms 1 through 3) will affect the horn driver circuit connected to J2 on the motherboard. Choices are **OFF, STEADY** or **PULSE**. Warning level alarms might be set to pulse the horn with high alarms set for steady. Personnel then know which alarm level is present by hearing the pulsing or steady horn.
- **Relay 2 Acknowledge** set to **ON** allows Relay 2 to be deactivated during alarm conditions by an **Alarm Reset**. This is useful if another audible device is being driven by the relay. The acknowledge feature is not available for Relay 1 since it is often used for driving a warning light and Relay 2 for driving a horn. It could be dangerous if an operator acknowledged the horn AND the light since no indication of the high alarm condition remains.
  IMPORTANT:
  If a **Sympathy** override is configured (see section 2.3.1) for relay 2, the local alarm reset does not acknowledge the relay. The relay may only be acknowledged from the network's ST-72 Modbus master controller.
- **Local Piezo** set to **ON** causes the tiny local piezo adjacent to the LCD to mimic the J2 horn output.

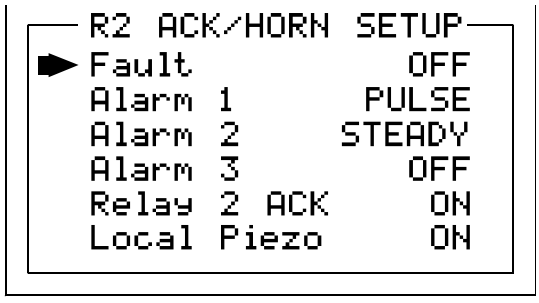


Figure 2.9

2.3.3 Clock/Delays Menu

These FMC-4 timers accommodate inputs that may require varying times to stabilize after power is applied and after calibrations are complete.

- **Alarm Refresh** menu allows reactivation of *Acknowledged* alarms after the time period expires. This feature is used primarily to restart audible alarm devices after having been silenced by an acknowledge function (via serial port or pressing the Alarm Reset button). An entry of 0 seconds effectively disables the **Alarm Refresh** function.
- **Warm Up Delay** menu allows setting how long alarm relays remain disabled after power is applied.
- **Cal Delay** determines how long alarm relays are inhibited after completing a calibration.
- **Time** and **Date** menu items are for setting the correct time and date. The FMC-4 is equipped with a 24-hour clock and calendar. Time of day must be entered in 24 hour mode. For example, 6:00:00 PM = is indicated as18:00:00.

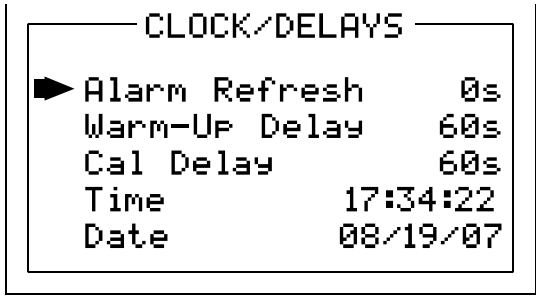


Figure 2.10

2.3.4 Modbus Communications Menu

The **COMM SETUP** menu allows setting of the system's Modbus port. It may function as a wired **Modbus Master / Slave** (requires 10-0253 serial option in Section 3.2). A very common application is to connect two FMC-4 controller's serial ports together with one set as *master* and one as *slave*. This allows the *master* to mimic readings from the *slave*.

- **Modbus Master** mode allows the communication port to poll any Modbus *slave* device using the Modbus RTU protocol.
- **Modbus Slave** mode allows the communication port to be polled by any Modbus *master* device using the Modbus RTU protocol. This *slave* port may be used to transfer FMC-4 data to a Modbus *master* device such as a PC, PLC, DCS or even other RAE Systems Controllers such as the 16-Channel FMC-16. The slave port is addressable, allowing many FMC-4 controllers to be connected to a single RS-485 cable. A converter is available to make this port also compatible with Ethernet TCP/IP networks.

The entire Modbus database, including registers and supported Function Codes, is documented in section 3.2.1.

2.3.5 Analog Setup Menu

The system **ANALOG SETUP** menus in Figure 2.12 allow setting the 11-bit A/D (analog to digital) counts and the 10-bit D/A (digital to analog) counts for each of the four channels. Use the **Set Channel** entry to scroll to the desired channel using the EDIT key. The live A/D counts value for the channel selected is also shown on the bottom of this screen.

The default setting for A/D counts is 400 for Min and 2000 for Max. This is based upon a 0-20mA input providing 0-2000 counts, or, 100 counts per mA input.

- **Min Counts / Max Counts** entries in the **INPUT SETUP** menus define the input A/D counts range for **Zero** and **Span** readings as described in section 2.2.4b. The default settings for each analog channel are 400 to 2000 counts. Standard inputs yield 400 counts at 4mA and 2000 counts at 20mA but, for example, if a special application requires the **Zero** reading at 6mA input and the **Span** reading at 18mA input the correct **A/D Min / Max Raw** counts would be 600 to 1800.00.
- **Min Counts / Max Counts** entries in the **OUTPUT SETUP** menus define the output D/A counts range for **Zero** and **Span** readings as described in section 2.2.4b. **OUTPUT SETUP** menus are only used when the FMC-4 is equipped with the 10-0308 4-20mA output option (Section 3.1.5). Ideally, 200 to 1000 yields a 4-20mA output but very slight modifications may be needed to provide precise 4mA and 20mA values for each channel.

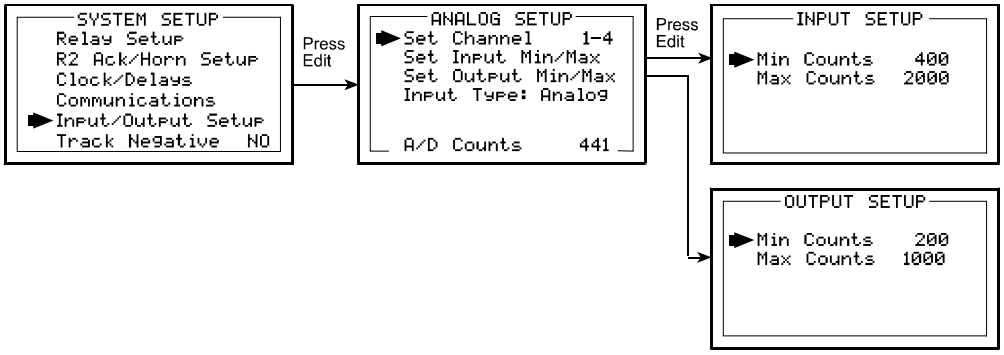


Figure 2.12

2.4 System Security Menu

A 4-digit **Pass Code** entered and confirmed in this menu item locks all menus. *Viewing* menus is not denied but attempts to *edit* variables flashes the ***Locked*** message on the LCD.

Authorized individuals locking the system should first enter a name, phone #, or other contact information into the 12 character field on the top line of the Security screen. To lock or unlock the system the correct 4 digit authorization number must be entered into

the **Pass Code** field. It is very important to remember the 4 digit code since the factory must be consulted if it is lost.

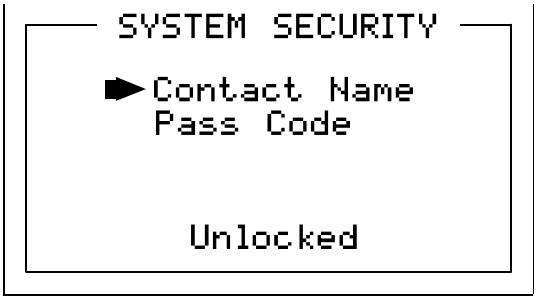


Figure 2.13

SECTION 3: INPUT/OUTPUT BOARDS

3.0 Motherboard Interface PCB #10-0215

The FMC-4 Motherboard shown below in Figure 3.1 is the interface between the Display/CPU assembly and all other system I/O devices. The Display / CPU assembly attaches to the motherboard with four standoffs and connects via ribbon cable to S1. Input options described in sections 3.1.1 and 3.1.2 are available that may be installed into the *Input Option* P1 connector located on the lower left side of the motherboard. The middle position P2 connector is for the 10-0308 4-20mA Output option and the right position P3 connector is for the 10-0222 Discrete Relay option. Other option devices such as Modbus RTU RS-485, Ethernet and a data logger may also be installed to connectors located on the Motherboard.

The Motherboard PCB contains a 24 VDC universal input (100-240 VAC) switching power supply with up to 350mA available at the TB3 Auxiliary Power Output terminals. If AC power is unavailable, or if a DC battery back-up supply is needed, TB1 provides terminals for DC power input. Blocking diodes isolate internal and external DC supplies as shown in Figure 3.0. See section 1.2.1 for additional power source information.

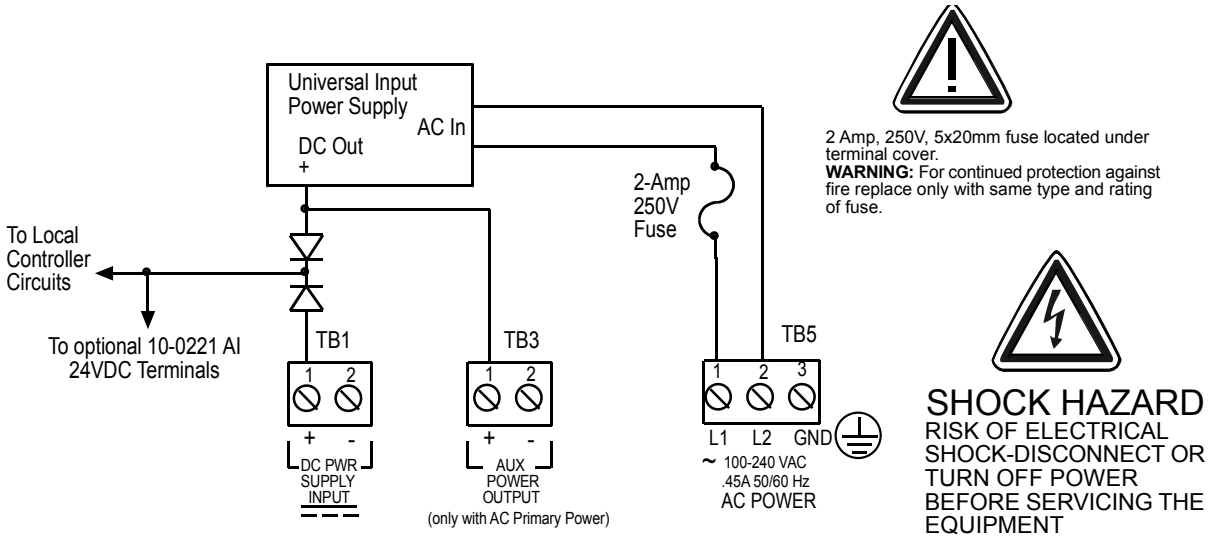


Figure 3.0

TB2 offers field terminals for a remote alarm reset switch. The motherboard also includes standard alarm relays 1 & 2 (K1 & K2) and their indicating LED's. TB4 provides field wiring terminals for these relays. TB5 is for connection to the 100-240 VAC power source. J2 is a 2-pin connector for powering the optional part # 1000-1892 audible annunciator.

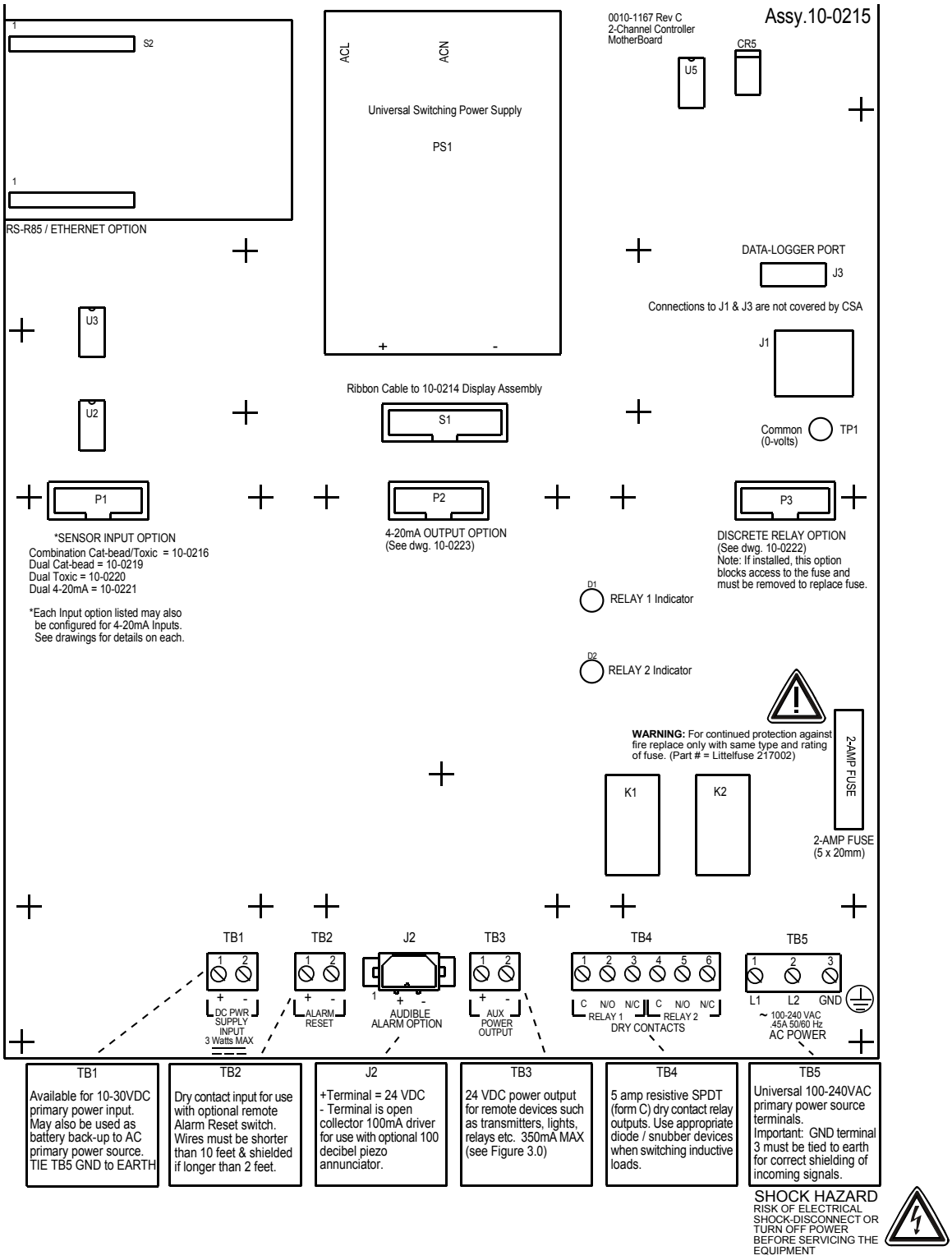

Assy.10-0215
0010-1167 Rev C
2-Channel Controller
MotherBoard
S2
RS-R85 / ETHERNET OPTION
ACL
ACN
Universal Switching Power Supply
PS1
CR5
U5
DATA-LOGGER PORT
J3
Connections to J1 & J3 are not covered by CSA
J1
U3
U2
Ribbon Cable to 10-0214 Display Assembly
S1
Common
(0-volts)
TP1
P1
P2
P3
*SENSOR INPUT OPTION
Combination Cat-bead/Toxic = 10-0216
Dual Cat-bead = 10-0219
Dual Toxic = 10-0220
Dual 4-20mA = 10-0221
*Each Input option listed may also be configured for 4-20mA Inputs. See drawings for details on each.
4-20mA OUTPUT OPTION
(See dwg. 10-0223)
DISCRETE RELAY OPTION
(See dwg. 10-0222)
Note: If installed, this option blocks access to the fuse and must be removed to replace fuse.
D1
RELAY 1 Indicator
D2
RELAY 2 Indicator
WARNING: For continued protection against fire replace only with same type and rating of fuse. (Part # = Littelfuse 217002)
2-AMP FUSE
2-AMP FUSE
(5 x 20mm)
K1
K2
TB1
TB2
J2
TB3
TB4
TB5
DC PWR SUPPLY INPUT 3 Watts MAX
ALARM RESET
AUDIBLE ALARM OPTION
AUX POWER OUTPUT
C N/O N/C
RELAY 1
C N/O N/C
RELAY 2
DRY CONTACTS
L1 L2 GND
~ 100-240 VAC .45A 50/60 Hz
AC POWER
TB1
Available for 10-30VDC primary power input. May also be used as battery back-up to AC primary power source. TIE TB5 GND to EARTH
TB2
Dry contact input for use with optional remote Alarm Reset switch. Wires must be shorter than 10 feet & shielded if longer than 2 feet.
J2
+Terminal = 24 VDC - Terminal is open collector 100mA driver for use with optional 100 decibel piezo annunciator.
TB3
24 VDC power output for remote devices such as transmitters, lights, relays etc. 350mA MAX (see Figure 3.0)
TB4
5 amp resistive SPDT (form C) dry contact relay outputs. Use appropriate diode / snubber devices when switching inductive loads.
TB5
Universal 100-240VAC primary power source terminals. Important: GND terminal 3 must be tied to earth for correct shielding of incoming signals.
SHOCK HAZARD
RISK OF ELECTRICAL SHOCK-DISCONNECT OR TURN OFF POWER BEFORE SERVICING THE EQUIPMENT

Figure 3.1

3.1 Input/Output Optional PCBs

P1, P2 and P3 connectors on the motherboard offer unique positions for I/O options described in this section. A screen appears briefly after power-up indicating what I/O options are connected. The P1 position accepts either the 10-0221-4 Analog Input option or the 10-0309 Bridge Sensor Input option. Both have default **Input Min/Max** menu (see section 2.3.4) settings of 400 to 2000 counts.

P2 is reserved only for the 10-0308 4-20mA Output option and P3 is reserved only for the 10-0222 Discrete Relay option. Connector locations, relative to each option's mounting screws, prevent incorrect installation.

3.1.1 Optional Analog Input PCB #10-0221-4

In compliance with CSA C22.2 No. 152 certification, the 4-20mA input does not include or imply approval of the LEL gas detection apparatus such as sensors, transmitters, or devices connected to the system. In order to maintain CSA Certification of the system, all 4-20 ma gas detection instruments connected to the input must also be CSA Certified.

Important! 10-0221-4 PCBs may only be installed into motherboard position P1.

Analog input PCB option # 10-0221-4, shown in Figure 3.2 allows interfacing FMC-4's to field transmitters having 4-20mA or voltage outputs. Remove socketed 100 ohm (R1 – R4) terminators for 0-4 VDC max voltage inputs. The 10-0221-4 utilizes a 12-bit A/D converter such that 4mA provides 400 counts and 20mA 2000 counts. Min/Max raw counts menus default to 400/2000 but may be adjusted between 0/4095 as described in the **A/D Min / Max Raw** discussion in section 2.3.4. TB1 & TB2 provide each channel's terminals for receiving analog inputs. TB1 & 2 also provides 4 terminals connected to the FMC-4 internal 24 VDC power supply for powering external transmitters. Figure 3.3 shows correct wiring for both 2-wire and 3-wire transmitters.

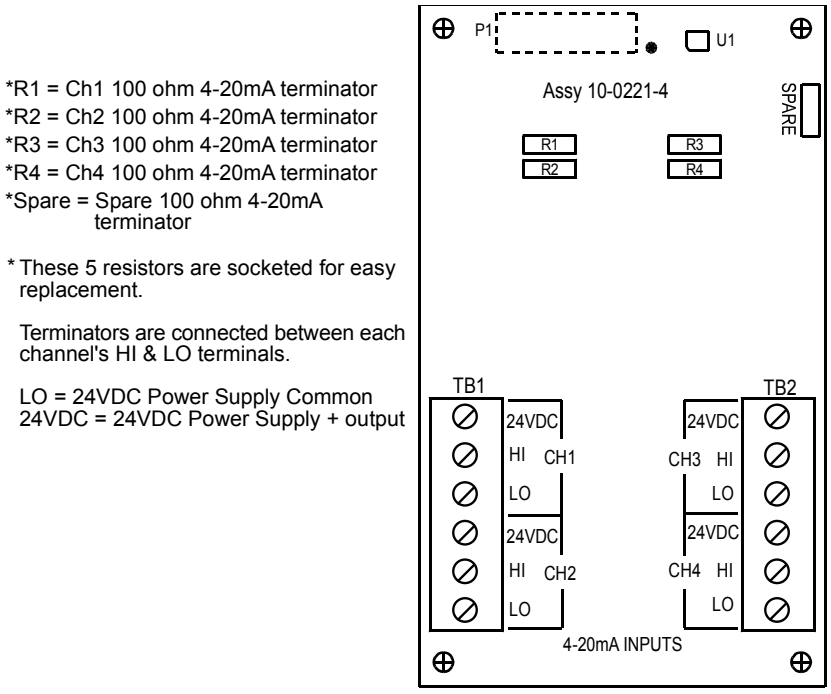


Figure 3.2

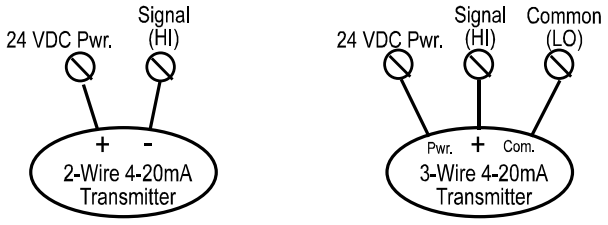


Figure 3.3

3.1.2 Optional Bridge Sensor Input Board #10-0309

Important! 10-0309 PCBs may only be installed into motherboard position P1.

The 10-0309 Quad Channel *Bridge Sensor Input* option shown in Figure 3.4 allows these popular sensors to be connected directly to the FMC-4 without additional signal conditioning or transmitters. Each channel is equipped with a bridge amplifier, balance potentiometer, and an adjustable switching regulator for setting the correct sensor excitation voltage. A 3 position coarse gain jumper allows setting the gain of the bridge amplifier. Fault supervision circuitry forces the FMC-4 into a FAULT condition upon sensor failure or removal.

This option may also be configured to accept 4-20mA inputs into channels 3 & 4 to allow mixing sensors and current loops into the same board. Placing either channel's 2 position LEL/4-20mA jumper (JP5 or JP6) into the 4-20mA position, and installing the associated precision 100 ohm socketed resistor, allows 4-20mA signals to be applied to the mA+ / mA- terminals (see *Optional 4-20mA notes* in Figure 3.4). Precision 100 ohm resistors are taped to the inside of the FMC-4 enclosure.

Bridge sensors require the *Initial Setup* calibration procedure described in section 3.1.3. After performing the one time only *Initial Setup* all subsequent calibrations are by the FMC-4's electronic Cal Mode menus (see section 2.2.5). Sensors mounted locally to the FMC-4 normally do not require *Initial Setup* since it is performed at the factory.

3.1.3 Bridge Sensor Initial Setup

Bridge sensors vary widely in power requirements and sensitivity. It is therefore important to configure each channel to match the sensor with which it will operate. **Sensors attached to the FMC-4 enclosure at the factory have already had *Initial Setup.***

1. Prior to connecting remote sensors, apply power to the system. Measure the voltage between each channel's A and R terminals and set the *Voltage Adjust* potentiometers for the correct sensor excitation voltage (remove FMC-4 terminal cover). This may range from 1.5 volts to 7.5 volts depending upon sensor specifications.

   CAUTION! Sensors may be damaged by accidental over-voltage conditions. It is recommended the *Voltage Adjust* potentiometer screws be covered by a dollop of RTV or similar material after completion of this procedure.

2. Remove system power and connect sensor wires to the A-C-R terminals. Reapply system power and confirm correct voltage across each sensor's A & R terminals. Note if sensor wires are long, it will be necessary to measure the excitation voltage at the sensor end to compensate for I * R voltage losses in the wiring.

3. With zero cal stimulus on that sensor, adjust its *Balance* potentiometer for a ZERO reading on the LCD.

4. Apply 50% span stimulus to the sensor and allow the reading to stabilize. Place the 3 position *Coarse Gain* jumper into the position which reads between approximately 45 and 65% with 50% on the sensor. Gain settings for each jumper position are as follows: no jumpers = 1, **LO** = 7, **MED** = 12, **HI** = 24. Multiple jumpers have an additive affect upon gain, so for example the **LO** and **MED** jumpers together provide a gain of 19.

Initial setup is now complete and normally only requires repeating if a sensor is replaced.

Note: Final calibration of this channel may now be performed using the FMC-4's electronic Cal Mode feature described in section 2.2.5.

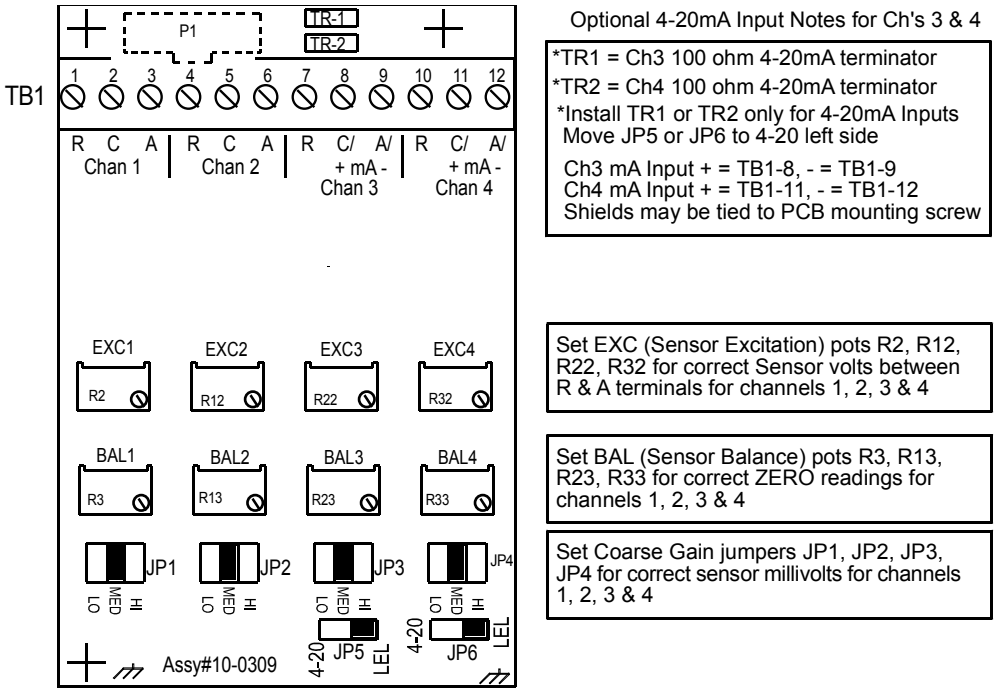

P1
TR-1
TR-2
TB1
1 2 3 4 5 6 7 8 9 10 11 12
R C A Chan 1
R C A Chan 2
R C/ A/ + mA - Chan 3
R C/ A/ + mA - Chan 4
EXC1 R2
EXC2 R12
EXC3 R22
EXC4 R32
BAL1 R3
BAL2 R13
BAL3 R23
BAL4 R33
JP1
JP2
JP3
JP4
LO MED HI
4-20 JP5 LEL
4-20 JP6 LEL
Assy#10-0309
Optional 4-20mA Input Notes for Ch's 3 & 4
*TR1 = Ch3 100 ohm 4-20mA terminator
*TR2 = Ch4 100 ohm 4-20mA terminator
*Install TR1 or TR2 only for 4-20mA Inputs
Move JP5 or JP6 to 4-20 left side
Ch3 mA Input + = TB1-8, - = TB1-9
Ch4 mA Input + = TB1-11, - = TB1-12
Shields may be tied to PCB mounting screw
Set EXC (Sensor Excitation) pots R2, R12, R22, R32 for correct Sensor volts between R & A terminals for channels 1, 2, 3 & 4
Set BAL (Sensor Balance) pots R3, R13, R23, R33 for correct ZERO readings for channels 1, 2, 3 & 4
Set Coarse Gain jumpers JP1, JP2, JP3, JP4 for correct sensor millivolts for channels 1, 2, 3 & 4

Figure 3.4

3.1.4 Optional Discrete Relay PCBs #10-0222

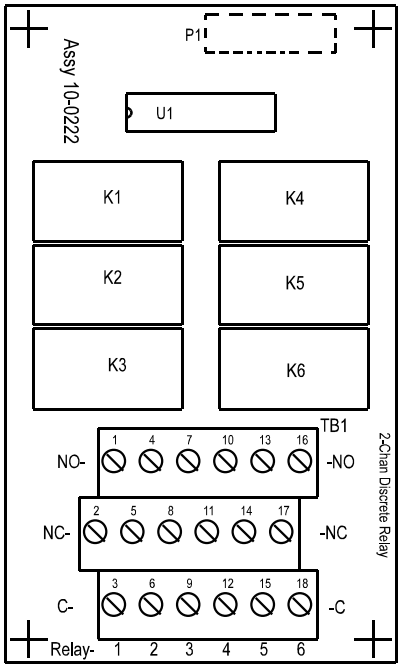
Important! 10-0222 PCBs may only be installed into motherboard position P3.

The optional *Discrete Relay PCB*, shown in Figure 3.5, adds six 5-Amp Form C relays. Each relay is fully programmable as described in section 2.3.1. Many FMC-4 applications utilize the standard equipped Relay 1/Relay 2 (see section 2.3.1) and do not require optional discrete relays

All mechanical (dry contact) relays are rated at 5 Amp for 28 VDC and 250 VAC resistive loads.

Important! Appropriate diode (DC loads) or MOV (AC loads) snubber devices must be installed with inductive loads to prevent RFI noise spikes.

AC or DC power supplies to relays on the 10-0222 Discrete Relay PCB option must be the same for each relay. Example: 24VDC should not be the power switched by one relay and 115VAC by others.



Note:
When installed, this option blocks access to the fuse and must be remove to replace a blown fuse.
WARNING: For continued protection against fire replace only with same type and rating of fuse.

K1, K2, K3, K4, K5 & K6 are programmable as described in Section 2.3.1.

TB1 terminals 1,4,7,10,13 & 16 are Normally Open Contacts for K1-K6

TB1 terminals 2,5,8,11,14 &17 are Normally Closed Contacts for K1-K6

TB1 terminals 3,6,9,12,15 & 18 are Common (pole) Contacts for K1-K6

Contacts are rated for 5 amp resistive loads. Arc suppressing snubber devices should be used for switching inductive loads.

Figure 3.5

3.1.5 Optional 4-20mA Analog Output Board #10-0308

Important! 10-0308 PCBs may only be installed into motherboard position P2.

An optional 10-bit 4-20mA analog output board, shown in Figure 3.6, may be added. Each channel's output will transmit 4mA for 0% readings and 20mA for 100% readings. If the FMC-4 primary power is 100 – 240 VAC or at least 24 VDC, 4-20mA outputs are capable of driving 20mA through a 750 ohm load. Outputs are self-powered and DC power should not be provided by the receiving device. Precision calibration of the 4-20mA output DAC (digital to analog converter) is accomplished via the **Analog Setup** menu as described in section 2.3.4.

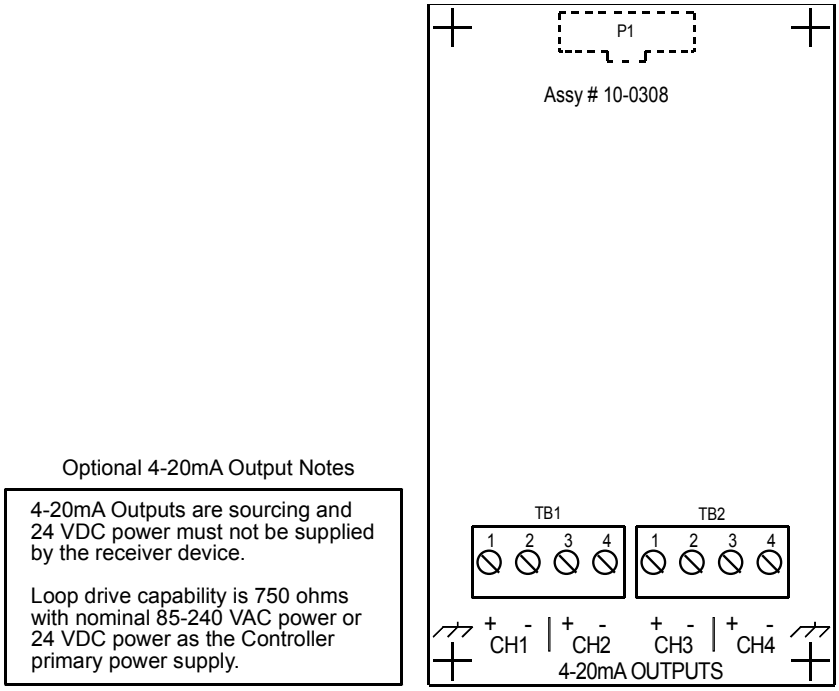

P1
Assy # 10-0308
Optional 4-20mA Output Notes
4-20mA Outputs are sourcing and 24 VDC power must not be supplied by the receiver device.
Loop drive capability is 750 ohms with nominal 85-240 VAC power or 24 VDC power as the Controller primary power supply.
TB1
TB2
1 2 3 4
1 2 3 4
+ - + - + - + -
CH1 CH2 CH3 CH4
4-20mA OUTPUTS

Figure 3.6

3.2 Modbus RS-232/RS-485 Interface Option 10-0253

In compliance with CSA C22.2 No. 152 certification, the Wireless/Modbus interface to an LEL gas detector may only be used for data collection or record keeping with regard to combustible gas detection and not for performance verification.

The 10-0253 Modbus option PCB add both RS-232 and RS-485 Modbus RTU slave ports. Figure 3.7 shows this optional PCB which mounts to connectors on the upper left corner of the FMC-4 motherboard. TB1 provides two pairs of T/Rx terminals and a floating terminal for shield continuation. This makes it easy to multi-drop FMC-4s onto an RS-485 cable without doubling wires into the same screw terminals. RS-232 interface may be made by connecting to DB9 connector S1. Section 3.2.1 lists all Modbus registers and their function codes.

Follow correct IEEE RS-232 and RS-485 installation guidelines when using the 10-0253 option.

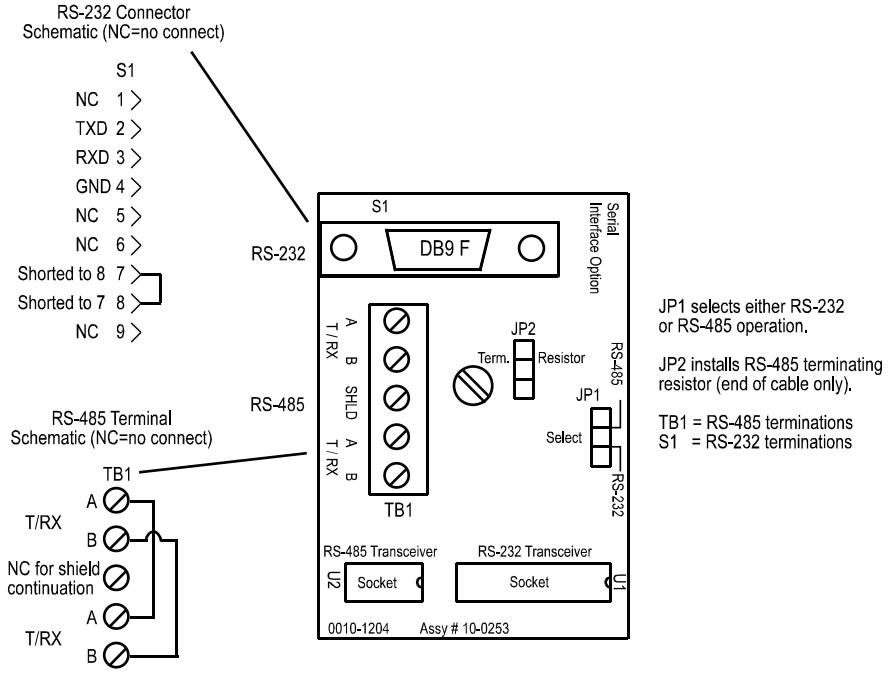


Figure 3.7

3.2.1 Modbus Register And Function Code Summary

The following table identifies the available modbus RTU register locations and function codes.

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE
Read/Write Coils:			
Alarm Ack/Reset	2001	1	5
Note: After writing a TRUE to this register, the FMC-4 automatically returns it to FALSE.			
Read Only Discrete:			
Chan 1 Fault Alarm	12001	2	NA
Chan 1 Alarm 1	12002	2	NA
Chan 1 Alarm 2	12003	2	NA
Chan 1 Alarm 3	12004	2	NA
Chan 2 Fault Alarm	12005	2	NA
Chan 2 Alarm 1	12006	2	NA
Chan 2 Alarm 2	12007	2	NA
Chan 2 Alarm 3	12008	2	NA
Chan 3 Fault Alarm	12009	2	NA
Chan 3 Alarm 1	12010	2	NA
Chan 3 Alarm 2	12011	2	NA
Chan 3 Alarm 3	12012	2	NA
Chan 4 Fault Alarm	12013	2	NA
Chan 4 Alarm 1	12014	2	NA
Chan 4 Alarm 2	12015	2	NA
Chan 4 Alarm 3	12016	2	NA
Standard Relay 1	12017	2	NA
Standard Relay 2	12018	2	NA
Optional Relay 1	12019	2	NA
Optional Relay 2	12020	2	NA
Optional Relay 3	12021	2	NA
Optional Relay 4	12022	2	NA
Optional Relay 5	12023	2	NA
Optional Relay 6	12024	2	NA
Input Fault Relay	12025	2	NA
Read Only Registers:			
Product ID	30001	4	NA
Returns the numeric value "1000" for product ID.			
Firmware value	30002	4	NA
Return a numeric value for firmware value as (Version divided by 100).			
D2A Chan 1	31001	4	NA
D2A Chan 2	31002	4	NA
D2A Chan 3	31003	4	NA
D2A Chan 4	31004	4	NA
12-bit value representing the D2A value of 800 (0%) to 4000(100%) after all cal features are applied.			

Chan 1 Status	31005	4	NA
Chan 2 Status	31006	4	NA
Chan 3 Status	31007	4	NA
Chan 4 Status	31008	4	NA

16 bit status word bit assignment for each channel.

ALARM1_BELOW_BIT	BIT1
ALARM2_BELOW_BIT	BIT2
ALARM3_BELOW_BIT	BIT3
ALARM1_LATCH_BIT	BIT5
ALARM2_LATCH_BIT	BIT6
ALARM3_LATCH_BIT	BIT7
WIRELESS INPUT	BIT4
CHANNEL_DISABLED_BIT	BIT9
CHANNEL_CAL_BIT	BIT10

System Status Word	31009	4	NA

16 bit status word bit assignment for system status.

TRACK NEGATIVE	BIT0
WIRELESS RECEIVER	BIT1
SECURITY LOCK	BIT15

Alarm Status Word	31010	4	NA

16 bit status word bit assignment for system status.

CHAN1 FAULT	BIT0
CHAN1 ALARM1	BIT1
CHAN1 ALARM2	BIT2
CHAN1 ALARM3	BIT3
CHAN2 FAULT	BIT4
CHAN2 ALARM1	BIT5
CHAN2 ALARM2	BIT6
CHAN2 ALARM3	BIT7
CHAN3 FAULT	BIT8
CHAN3 ALARM1	BIT9
CHAN3 ALARM2	BIT10
CHAN3 ALARM3	BIT11
CHAN4 FAULT	BIT12
CHAN4 ALARM1	BIT13
CHAN4 ALARM2	BIT14
CHAN4 ALARM3	BIT15

LED Blink Status	31011	4	NA

Bit set to 1 = LED Blinking, bit set to 0 = LED is steady ON.

CHAN1 FAULT	BIT0
CHAN1 ALARM1	BIT1
CHAN1 ALARM2	BIT2
CHAN1 ALARM3	BIT3
CHAN2 FAULT	BIT4
CHAN2 ALARM1	BIT5
CHAN2 ALARM2	BIT6
CHAN2 ALARM3	BIT7
CHAN3 FAULT	BIT8

CHAN3 ALARM1	BIT9
CHAN3 ALARM2	BIT10
CHAN3 ALARM3	BIT11
CHAN4 FAULT	BIT12
CHAN4 ALARM1	BIT13
CHAN4 ALARM2	BIT14
CHAN4 ALARM3	BIT15

Relay Status	31012	4	NA

Note: 1 = energized; 0 = de-energized

STANDARD RELAY 1	BIT0
STANDARD RELAY 2	BIT1
OPTION RELAY 1	BIT2
OPTION RELAY 2	BIT3
OPTION RELAY 3	BIT4
OPTION RELAY 4	BIT5
OPTION RELAY 5	BIT6
OPTION RELAY 6	BIT7
COMMON FAULT (no relay)	BIT8
Reserved	BIT9
Reserved	BIT10
Reserved	BIT11
Reserved	BIT12
Reserved	BIT13
Reserved	BIT14
Reserved	BIT15

VARIABLE	ALIAS	READ FUNCTION CODE	WRITE FUNCTION CODE

Memory Reals:

Notes: 41001 – 41040 "Real" represents float value without the decimal point such that 123.4 is returned as 1234. Decimal devisor is returned as 1, 10, 100, or 1000 for decimal position of 1, 2, 3, or 4, where 123.4 would return the devisor value 10.

Chan 1 Zero Real	41001	3	NA
Chan 1 Zero Divisor	41002	3	NA
Chan 1 Span Real	41003	3	NA
Chan 1 Span Divisor	41004	3	NA
Chan 1 Fault Alarm Real	41005	3	NA
Chan 1 Fault Alarm Divisor	41006	3	NA
Chan 1 Alarm 1 Real	41007	3	NA
Chan 1 Alarm 1 Divisor	41008	3	NA
Chan 1 Alarm 2 Real	41009	3	NA
Chan 1 Alarm 2 Divisor	41010	3	NA
Chan 1 Alarm 3 Real	41011	3	NA
Chan 1 Alarm 3 Divisor	41012	3	NA
Chan 2 Zero Real	41013	3	NA
Chan 2 Zero Divisor	41014	3	NA
Chan 2 Span Real	41015	3	NA
Chan 2 Span Divisor	41016	3	NA
Chan 2 Fault Alarm Real	41017	3	NA
Chan 2 Fault Alarm Divisor	41018	3	NA
Chan 2 Alarm 1 Real	41019	3	NA

Chan 2 Alarm 1 Divisor	41020	3	NA
Chan 2 Alarm 2 Real	41021	3	NA
Chan 2 Alarm 2 Divisor	41022	3	NA
Chan 2 Alarm 3 Real	41023	3	NA
Chan 2 Alarm 3 Divisor	41024	3	NA
Chan 3 Zero Real	410251	3	NA
Chan 3 Zero Divisor	41026	3	NA
Chan 3 Span Real	41027	3	NA
Chan 3 Span Divisor	41028	3	NA
Chan 3 Fault Alarm Real	41029	3	NA
Chan 3 Fault Alarm Divisor	41030	3	NA
Chan 3 Alarm 1 Real	41031	3	NA
Chan 3 Alarm 1 Divisor	41032	3	NA
Chan 3 Alarm 2 Real	41033	3	NA
Chan 3 Alarm 2 Divisor	41034	3	NA
Chan 3 Alarm 3 Real	41035	3	NA
Chan 3 Alarm 3 Divisor	41036	3	NA
Chan 4 Zero Real	41037	3	NA
Chan 4 Zero Divisor	41038	3	NA
Chan 4 Span Real	41039	3	NA
Chan 4 Span Divisor	41040	3	NA
Chan 4 Fault Alarm Real	41041	3	NA
Chan 4 Fault Alarm Divisor	41042	3	NA
Chan 4 Alarm 1 Real	41043	3	NA
Chan 4 Alarm 1 Divisor	41044	3	NA
Chan 4 Alarm 2 Real	41045	3	NA
Chan 4 Alarm 2 Divisor	41046	3	NA
Chan 4 Alarm 3 Real	41047	3	NA
Chan 4 Alarm 3 Divisor	41048	3	NA

Memory ASCII Strings:

User Info Chan 1	40401-40405	3	NA
User Info Chan 2	40406-40410	3	NA
User Info Chan 3	40411-40415	3	NA
User Info Chan 4	40416-40420	3	NA

10 ASCII characters (2 per register) assigned to the unit identifier read as bytes.

EUNITS Chan 1	40421-40425	3	NA
EUNITS Chan 2	40426-40430	3	NA
EUNITS Chan 3	40431-40435	3	NA
EUNITS Chan 4	40436-40440	3	NA

10 ASCII characters (2 per register) assigned to the engineering units read as bytes.

Chan 1 ASCII Reading	40441-40443	3	NA
Chan 2 ASCII Reading	40444-40446	3	NA
Chan 3 ASCII Reading	40447-40449	3	NA
Chan 4 ASCII Reading	40450-40452	3	NA

6 ASCII characters (2 per register) reflecting the display readout.

Firmware Version:

Version	40453-40455	3	NA

4 ASCII characters (2 per register) reflecting the firmware version.

Sympathy:

Notes: 40004 registers are utilized by our ST-72 controller when a Modbus network is configured for sympathy (see section 2.3.1). This feature must be configured in both the ST-72 Modbus master controller and the FMC-4 Modbus slave controllers to function.

Sympathy Status 0=FALSE, 1=TRUE	40004	NA	6

FAULT	BIT0
ALARM 1	BIT1
ALARM 2	BIT2
ALARM 3	BIT3
Acknowledge	BIT15

3.3 Optional 24VDC 50-Watt Power Supplies

Many applications require 24VDC power in excess of the 10 watts supplied by the PS1 power supply located on the motherboard (see Figure 3.1). "Extended" enclosure models (see Section 4) may be equipped with an integral 1000-2259 NEC Class 2 FIFTY WATT supply are available for Division 1 (P/N 10-0314) and Division 2 (part # 10-0315) potentially hazardous area installations and both also include a NEMA 4X weather rating.

"EXTENDED" series enclosures described in Section 4 of this manual may include the 1000-2259 DIN rail mounted 50-watt Power Supply module built into these larger enclosures.

SECTION 4

4.0 FMC-4PY NEMA 4X Polycarbonate Wall Mount (Extended)

The FMC-4PY/QUAD wall mount NEMA 4X enclosure is shown in Figure 4.0. Non-metallic enclosures are not grounded by metal conduit. For internal ground points to be grounded to earth, the TB5 – GND terminal must have a proper earth ground connection (see Figure 3.1).

CAUTION: NONMETALLIC ENCLOSURE DOES NOT PROVIDE GROUNDING BETWEEN CONDUIT CONNECTIONS. USE GROUNDING-TYPE BUSHINGS AND JUMPER WIRES. ALL FIELD WIRING MUST HAVE INSULATION SUITABLE FOR AT LEAST 250V.

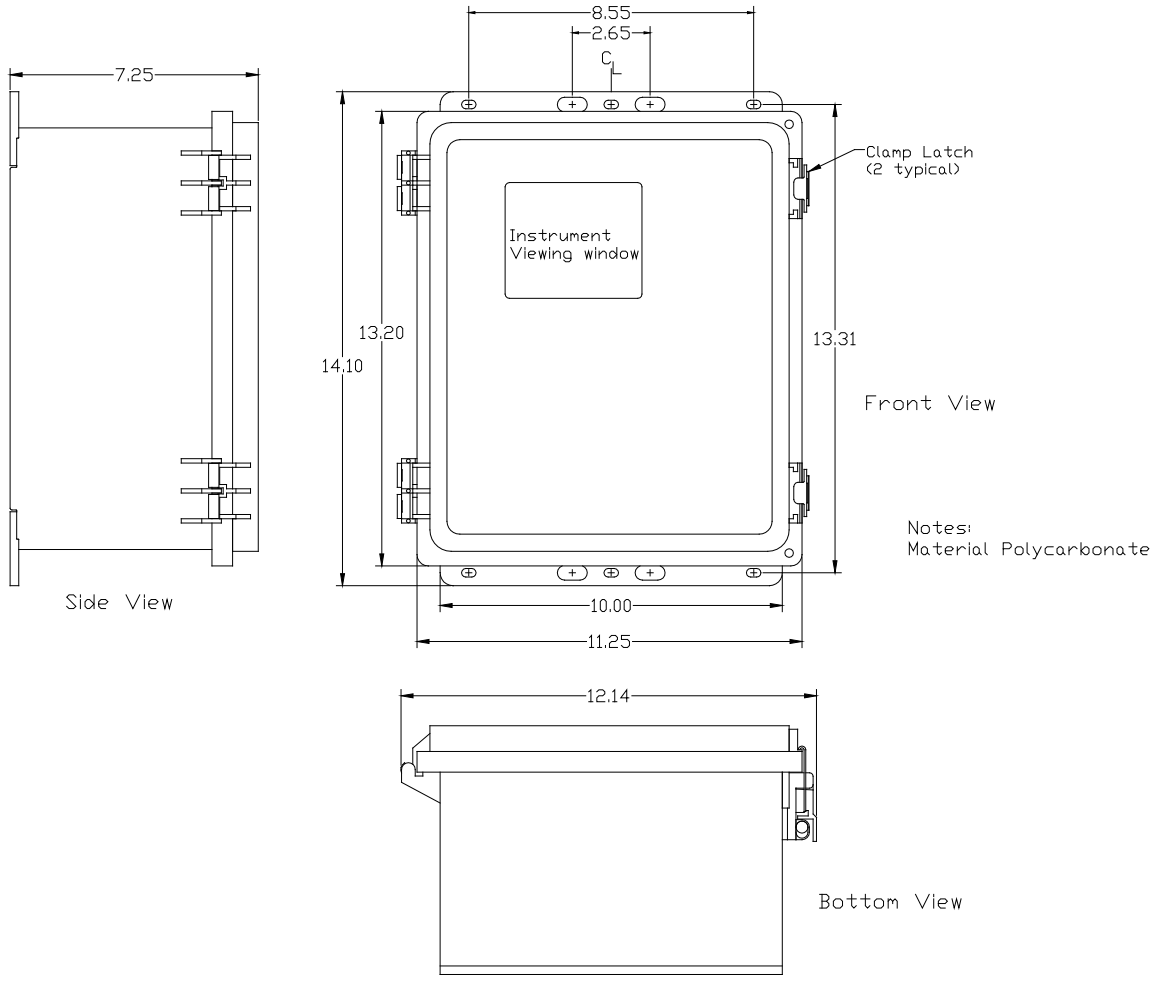


Figure 4.0

4.1 FMC-4PCS NEMA 4 Painted Steel Wall Mount (Extended)

The FMC-4PCS/QUAD shown in Figure 4.1 is a Painted Carbon Steel NEMA 4 wall mount enclosure designed for non-corrosive installations.

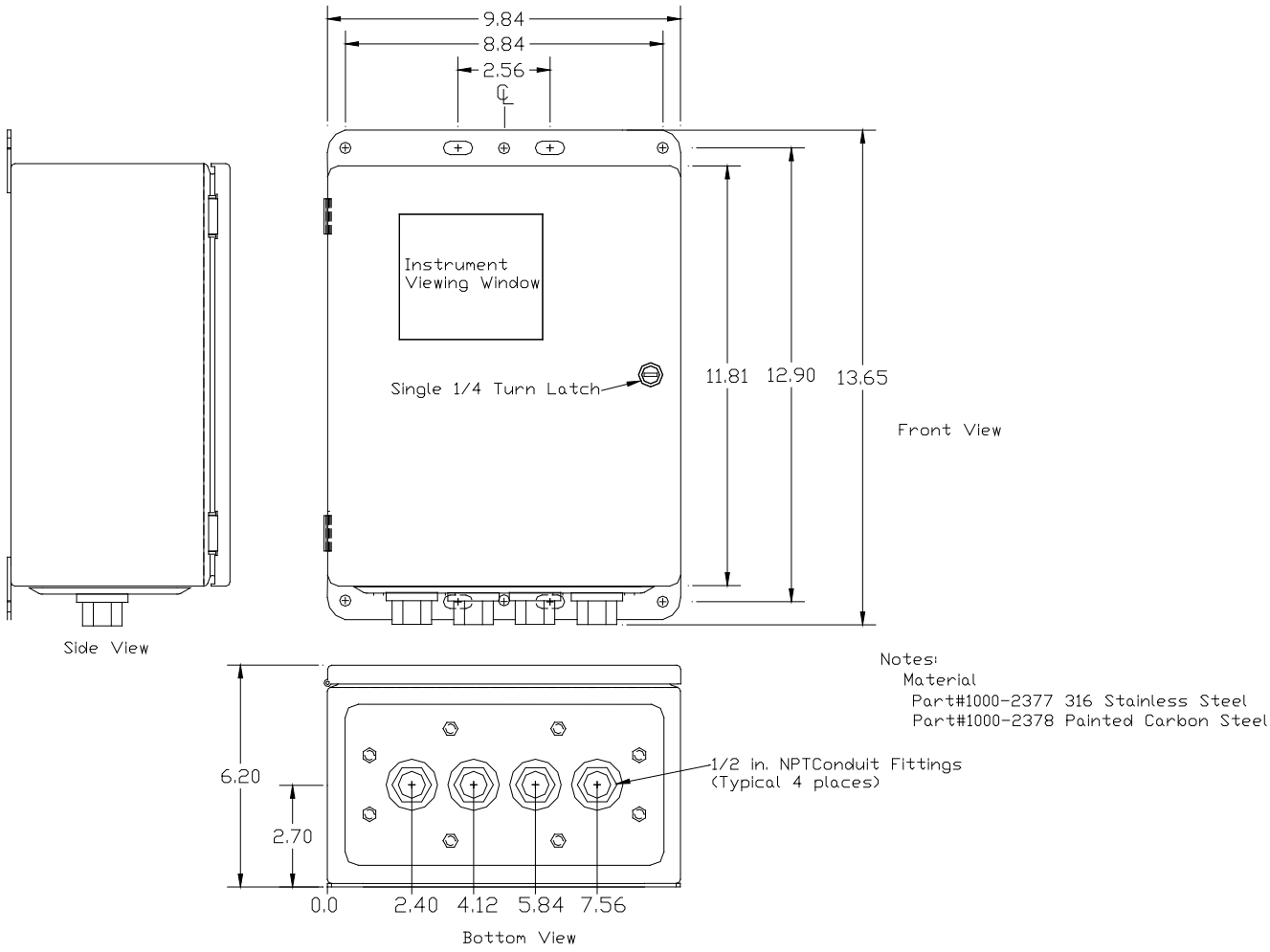


Figure 4.1

4.2 FMC-4SS NEMA 4X Stainless Steel Wall Mount (Extended)

The FMC-4SS/QUAD shown in Figure 4.2 is a 316 Stainless Steel NEMA 4X wall mount enclosure designed for corrosive installations.

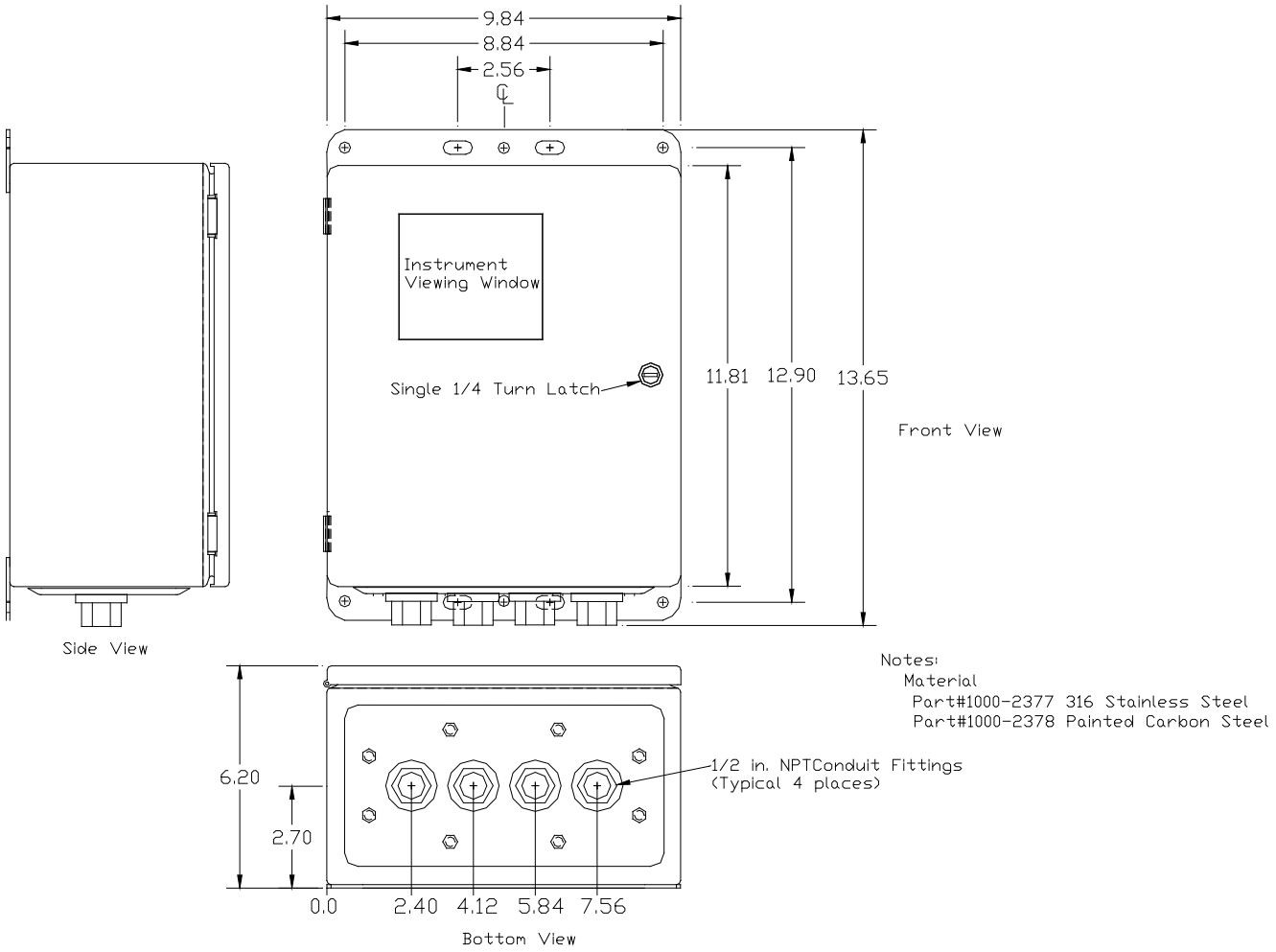


Figure 4.2

4.3 FMC-4XP NEMA 7 Explosion-Proof Wall Mount (Extended)

The FMC-4XP/QUAD shown in Figure 4.3 is an aluminum NEMA 7 wall mount enclosure designed for mounting into potentially hazardous.

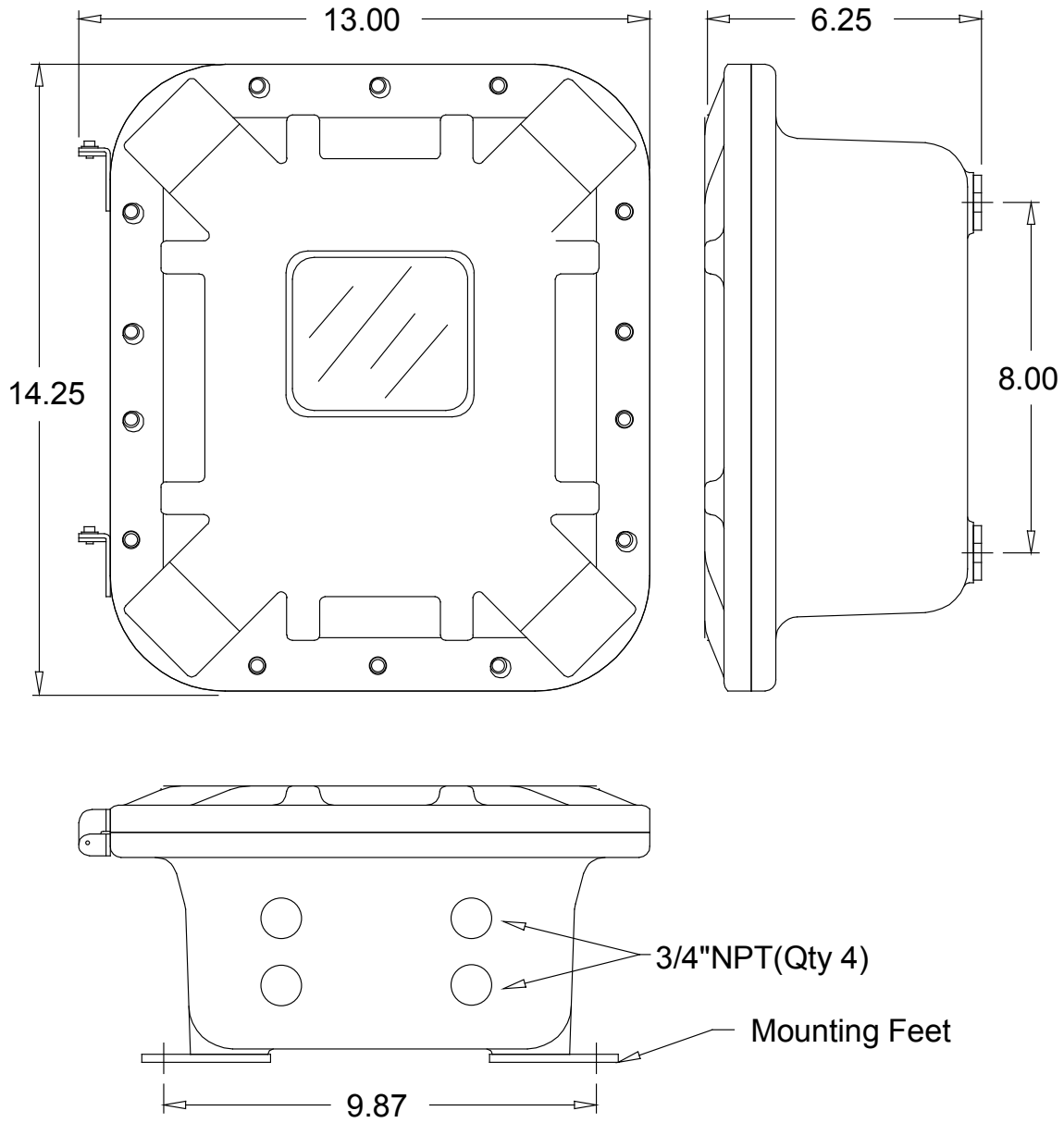


Figure 4.3

SECTION 5: PARTS REFERENCE

Manufacturing Number	RAE Systems Ordering Part Number	Part Description
0010-0321	RC01-0321-000	Aluminum 19" Expansion Plate (Adds Qty 4 Option Boards)
0010-1002	RC01-1002-000	16"- Long 40-Pin I/O Ribbon Cable
0010-1110	RC01-1110-000	6"- Long I²C Cable
0010-1120	RC01-1120-000	6'-Long I/O PCB Ribbon Cable
0010-1180	RC01-1180-000	10"- Long I²C Cable
0010-1188	RC01-1188-000	6'-Long I²C Cable
0010-1269	RC01-1269-000	NEMA 4 Expansion Plate (Adds Qty 5 Option Boards)
0010-1284	RC01-1284-000	NEMA 7 XP Expansion Plate (Adds Qty 2 Option Boards)
0010-1287	RC01-1287-000	6 foot Long 40 Pin I/O Ribbon Cable
10-0006	RC10-0006-000	Replacement FMC-16 Flat Panel LCD Module
10-0142	RC10-0142-000	Replacement Main I/O PCB For FMC-16/N4 & FMC-16/XP
10-0144	RC10-0144-000	Auxiliary Common Alarm Relay Board
10-0158	RC10-0158-000	I²C Analog 8 Inputs Including EXC Terminals (1 board)
10-0167	RC10-0167-000	I²C ANALOG 4-20mA 8-Output Board
10-0172	RC10-0172-000	85-240VAC Universal Input 150-Watt 24VDC Power Supply
10-0178	RC10-0178-000	NEMA 4X Expansion Enclosure For Up To 8 Option PCBs
10-0180	RC10-0180-000	NEMA 4X Expansion Kit (Adds Up To 4 Optional Positions)
10-0181	RC10-0181-000	NEMA 7 Expansion Kit (Adds Up To 3 Optional Positions)
10-0185	RC10-0185-000	Replacement Complete FMC-16 Front Panel Electronic Nest Assembly Including 10-0006 LCD
10-0195	RC10-0195-000	I²C Discrete Alarm Relay Board (Qty 8 5A Form C Relays)
10-0208	RC10-0208-000	Full Width 19" Rack (Supports 1 or 2 FMC-16SM's)
10-0213	RC10-0213-000	Replacement Main I/O PCB For FMC-16PM (Ribbon Connector On Circuit Side Of PCB)
10-0214/Dual	RC10-0214-002	FMC-2/Dual LCD/Microcontroller PCB & Ribbon Cable
10-0214/Quad	RC10-0214-004	FMC-2/Quad LCD/Microcontroller PCB & Ribbon Cable
10-0215	RC10-0215-000	FMC-2 Dual/Quad Mother Board PCB Assembly (Specify Enclosure Type)
10-0221/Dual	RC10-0221-002	Dual-Channel 4-20mA Input
10-0221/Quad	RC10-0221-004	Quad-Channel 4-20mA Input
10-0222	RC10-0222-000	Optional alarm relay board (6, 5A form C relays)
10-0223	RC10-0223-000	Dual 4-20mA output
10-0231	RC10-0231-000	Replacement FMC-16 Front Graphic Panel
10-0253	RC10-0253-000	RS-232/RS-485 Modbus RTU Addressable Interface
10-0284	RC10-0284-000	Red Strobe Light Suitable For Div 2 Hazardous Areas
10-0285	RC10-0285-000	Yellow Strobe Light Suitable For Div 2 Hazardous Areas
10-0308	RC10-0308-000	Quad 4-20mA Output
10-0316	RC10-0316-000	Blue Strobe Light Suitable For Div 2 Hazardous Areas
10-0319	RC10-0319-000	Magnetic Mounting Kit (Qty 4 Magnets)
10-0321	RC10-0321-000	19" Rack 6-Position Expansion Plate (Adds Up To 6 Option Positions)

10-0331	RC10-0331-000	Replacement FMC-64 Main I/O
10-0332	RC10-0332-000	Auxiliary Standard Alarm Relay Board
10-0337	RC10-0337-000	100dB Piezo Audible Alarm Added To Nema 4x Enclosure
10-0344	RC10-0344-000	I²C Analog 16 Inputs Including EXC Terminals (1 board)
10-0345	RC10-0345-000	I²C Discrete Alarm Relay Board (16, 5A Form C Relays)
10-0347	RC10-0347-000	I2C Bridge Sensor/mA Input Board (accepts up to 8 10-0192 modules)
10-0348	RC10-0348-000	I²C Analog 16 Output Board
10-0350	RC10-0350-000	I²C Programmable Alarm Relay Board (16, 5A Form C Relays)
10-0367	RC10-0367-000	100-240VAC Universal Input 600 Watt 24VDC Power Supply (27.0 Amps)
10-0368	RC10-0368-000	RS485 Isolated Expansion Board
10-0373	RC10-0373-000	Replacement Complete FMC-64 Front Panel Electronic Nest Assembly
10-0374	RC10-0374-000	Replacement FMC-64 Front Graphic Panel
1000-1892	RC1K-1892-000	100 dB Piezo Audible Alarm (only available for NEMA 4X enclosures)
1000-1992	RC1K-1992-000	Replacement Main I/O PCB Fuse; 20mm/2 A
1000-2158	RC1K-2158-000	Replacement Fiberglass Enclosure For FMC-16N4
1000-2259	RC1K-2259-000	50 Watt AC/DC Power Supply Module; Division 2
1000-2373	RC1K-2373-000	120 Watt AC/DC Power Supply Module; Division 2
71-01	RC71-01xx-xxx	NEMA 4X Fiberglass (Div 2) - Supports Main I/O board + up to 3 additional I/O boards
71-02	RC71-02xx-xxx	NEMA 7 Steel (Div 1) - Supports Main I/O board + up to 5 additional I/O boards
71-03	RC71-03xx-xxx	Panel, Main I/O Board + Ribbon Cable
71-04	RC71-04xx-xxx	Panel Mount Rack (includes Bezel/Rack Hardware) With Half 19" rack - Supports Main I/O board + up to 2 additional I/O boards
71-06	RC71-06xx-xxx	NEMA 4X Stainless Steel (Div 2) - Supports Main I/O board + up to 3 additional I/O boards
72-01	RC72-01xx-xxx	Panel Mount Rack with half 19" rack (includes Bezel/Rack Hardware) - Supports Main I/O board + up to 1 additional I/O boards
72-02	RC72-02xx-xxx	One controller in full-width 19" rack (includes Bezel/Rack Hardware) - Supports Main I/O board + up to 3 additional I/O boards
72-03	RC72-03xx-xxx	Two controllers in full width 19" rack (128 channels) - Call for help with configuration
72-04	RC72-04xx-xxx	NEMA 4X large fiberglass enclosure - Supports Main I/O board + up to 6 additional I/O boards
72-05	RC72-05xx-xxx	NEMA 4X 316 Stainless Steel Enclosure - Supports Main I/O board + up to 6 additional I/O boards
72-06	RC72-06xx-xxx	Bolt-On Lid NEMA 7 Enclosure (Div 1) - Supports Main I/O board + up to 3 additional I/O boards
72-07	RC72-07xx-xxx	NEMA 4X Compact Non-Metallic Enclosure - Supports Main I/O board + 0 additional I/O boards
90-02	RC90-02xx-xxx	ST-90XP/Dual Bolt-On Lid NEMA 7 Enclosure

90-03	RC90-03xx-xxx	ST-90PY/Dual NEMA 4X Non-Metallic Extended Enclosure
90-04	RC90-04xx-xxx	ST-90PCS/Dual NEMA 4 Painted Carbon Steel Extended Enclosure
90-05	RC90-05xx-xxx	FMC-2SS/Dual NEMA 4X Stainless Steel Extended Enclosure
90-12	RC90-12xx-xxx	FMC-2XP/Quad In Bolt-On Lid NEMA 7 Enclosure
90-50	RC90-50xx-xxx	FMC-2PY/Quad In NEMA 4X Non-Metallic Extended Enclosure
90-51	RC90-51xx-xxx	FMC-2PCS/Quad In NEMA 4 Painted Carbon Steel Extended Enclosure
90-52	RC90-52xx-xxx	FMC-2SS/Quad In NEMA 4X Stainless Steel Extended Enclosure
90-71	RC90-71xx-xxx	FMC-2PM/Quad Panel Mount With Extended Pushbuttons & 6' Ribbon Cable

SECTION 6: TECHNICAL SUPPORT

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